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CREEPING AND WALKING.

By AUGUST W. TRETTIEN.

When we look upon an infant which is just taking its first breath of vital air, we cannot but feel the full import of Linnæus's definition of it, when he said—"Naked and without weapons."

Other mammals possess natural means of protection and defence; some wear a warm fur, others possess agility and swiftness of foot soon after birth, but man has nothing of the kind for many months after he begins his separate existence.

We are also struck with the peculiar purposeless character of the movements of the human infant, apparently without control or rhythm, without administering to the immediate necessities of life. An infant, come to make its way through a life of necessity with only a possibility as its individual heritage.

On the other hand, we look upon man in his full possession of power and stature and contrast his form and appearance with that of other vertebrate creatures, we are equally struck with his capability of assuming an attitude which is distinctly his own, which has been termed the erect attitude. In this position the head is balanced perfectly upon the summit of the spine; the inferior extremities are elongated and brought into straight line with the body for support and locomotion, and the superior limbs hang gracefully at the side of a beautifully curved trunk. As Huxley says—"he stands raised up as on a mountain top, far above the lead of his humble fellows, and transfigured from his grosser nature by reflecting, here and there, a ray from the infinite source of truth."[1]

The whole position is in striking contrast with the attitude

[1] Man's Place in Nature. p. 132.

of the fishes of the sea, the fowls of the air or the beasts of the fields, whose long axis of body is parallel with the surface of the earth over which they move.

It is indeed strange that this erect attitude of the human body, which conjoins with it the discharge of the highest faculties of man, has not been heretofore a subject of more extended investigation.

It is the purpose of this study to trace the various stages and attitudes assumed by the infant and the movements which it employs in passing from this helpless stage of infancy to the time when the straightness and uprightness of body is taken. The data upon which this study is based, has been carefully selected from Medical Journals, Hospital Reports, and from the returns of a syllabus on the Straightness and Uprightness of Body. These returns have been the direct observations of individual cases and the writer has sought to verify the results by personal observations.

The Embryo.

Before we can approach the problem as it is presented to us in the infant at birth, it is necessary to consider briefly some of the determining factors during the embryonic life. At the stage of fœtal life when the embryonic body takes shape out of the embryonic disk, there is a conspicuous enlargement of the head and neck, as compared with the body, accompanied by a dilatation of the medullary canal to form the brain. Shortly the head makes a distinct bend forward and downward at about its middle, and the posterior end, which at first curves slightly upward, curls over ventrally, and as the back curves with it, the dorsal outline of the entire embryo becomes convex. This convexity increases so that in the embryo of about 30 days' growth the head and tail closely approximate, having the (Fig. 12 72, p. 190, Vol. III, Buck's Rep. H. Book, m. sc.) form of the letter C, and is from four to eight mm. in length on the straight line.

The anterior and posterior limbs have already made their appearance as small buds on the two sides of the body. Soon the fore-arm, the leg, and the arm and thigh successively make their appearance.[1] M. Hamy took the measurements of Zue, Gunz and Liharzic, and showed that at about the fourteenth day of intrauterine life the fore-arm of the European is longer than the humerus, while from two and one-half months the humerus grows proportionately faster. At this period the ratio existing between the fore-arm and the arm is 88 to 100, at birth this ratio

[1] Topinard: Anthropology, p. 141. Reference Hand Book of Medical Science. Dr. Buck, Vol. III. Embryology. Dr. Minot.

is 77:100, and at maturity 72:100. The femur is also relatively small during this early period.

During the time to the fiftieth day of growth a well marked change takes place in the external form of the embryo. The body now becomes nearly straight, with an area about the same as that of the head; the limbs are distinctly divided into an upper and lower division; the hand makes its appearance with notches along the edge of the distal end from which converging grooves run; and two weeks later the five digits are well developed. The lower limbs are also divided, the feet are plainly marked, and the toes are becoming free. On the whole the development of the posterior extremities is outstripped by that of the anterior. The bend in the neck has diminished from a right angle to an obtuse angle. At the period of two months the embryo has a distinctly human appearance in all parts, despite the disproportions of the same. There is now an increased development of the legs and feet and the disappearance of the free tail. (Fig. 224, Minot, p. 392.) Measurements of the extremities of different fœtal skeletons at the approximate ages of four, six and eight months give the following results:

Length of Fœtus. Length in Inches.	Length of Spinal Column.	Length of Arm.	Length of Leg.	Age. Approximated According to Hacker.
7.80	4.12	2.72	2.80	4.4 mos.
10.77	4.94	3.86	4.07	5.4 "
15.70	6.67	5.51	6.18	7.9 "

The following table expresses the ratio of the extremities:

Age.	Length in Inches. Body.	Arm.	Leg.	
4.4 mos.	7.80	100	102.9	
5.4 "	10.77	100	105.6	
7.9 "	15.70	100	112	
17 "		100	136	
[1]Adult.		100	143	Taken from Hamy's Measurements.

Position in Utero.[3]

The position which the fœtus assumes in utero without doubt determines the position of the extremities with reference to the

[1]Topinard Anthropology, p. 85.

* The manner of estimating the age of these embryos was taken from Hacker's measurements, which show that the fœtus at three and four months is three and four inches respectively, at five, six, seven and eight months the average length may be determined in inches by doubling the time; at nine and ten months the length is seventeen and eighteen inches respectively.

*Diseases of Infancy and Childhood, Dr. Holt.

[3]Minot: Embryology, p. 394.

body for some weeks after birth, and consequently the early movements are affected.

In utero the head is bent forward, the back contains one continuous concave curve forward without the lumbar convexity of later development; the extremities are drawn toward the body, the arms are bent forward and crossed over the breast with the fingers touching; the legs are raised forward, the right leg nearly always straight across the body with the toes resting against the forehead, while the left leg is bent at the knee bringing the left foot against the right thigh. In another position, the legs are crossed over the lower abdomen. The babe rests generally upon the right side. This attitude gives the muscles the greatest relaxation, and to the cartilage, which caps the bones, the position most favorable to nutrition and growth. At the same time the embryo forms as nearly as possible an oval, and thus occupies the smallest possible space.

Prenatal Movements.

It is believed by Professor Preyer and others that the movements of the infant immediately after birth do not essentially differ from the parental movements, except that they are given a wider range. The parental movements are entirely purposeless and are spontaneous or reflex. The former are those movements which are due to diffused stimuli from the growth of the lower motor centers, the latter movements immediately follow external stimulation. Professor Preyer states as a certainty that these movements are present in an embryo at five months' growth, and to substantiate this statement he cites an experiment of Erbham, which shows conclusively that even at four months the movements are possible from the stage of development of the muscular and nervous systems. Erbham placed a four month fœtus into a small vessel of warm water which furnished a sufficient external stimulus to cause a contraction of the muscles of the extremities and neck, to move these members in a natural manner. For one-half hour it was observed that the limbs moved before the body and the head turned from side to side.

Medical writers who place the evidence of movements considerable later, usually refer to the larger movements of swallowing, clasping and stretching as outgrowths of he simpler reflex movements to which Prof. Preyer refers.[1]

Like every other organic formative process, the origin of the human body and of its nervous system appears as an expression of a life process in course of progress, the beginning of which we do not know. What we do know is that very early in

[1] Preyer: Physiologie des Embryo, p. 431.

the embryonic life, when the body and nervous system attain a certain stage of development, a disturbance without causes a nerve stimulus which in turn produces muscular contraction. The infant, before birth, is living in an environment where the external stimulation is limited, the amniotic fluid in which the fœtal body rests is of uniform temperature with the body, yet it receives peripheral stimulation which is transmitted to it from the body of the parent—the beating of the heart, the movements of respiration, the change of position and posture and the movements of walking, all have their direct influence in stimulating the organism of the fœtus.

These stimuli start the nerve mechanism which has become so complicated and interrelated that a given irritation never affects one cell only, but rather is conducted from a point in the periphery by the fiber to a nerve center which may innervate a large collection of motor cells. A subsequent stimulus in like manner excites a sensory cell, which according to the anatomical relations of the sensory and motor cells, may bring an entire system of muscles into contraction.

In this manner Exner has explained how a single sensory impression may lead to a complicated movement in which many muscles take part. There is a close relationship, says Edinger,[1] established between the different sensory nerves and their motor reactions, and there is much evidence in favor of the view that such relationships, when once established in the course of evolution, are afterwards inherited. The nervous system, then, consists of two parts—one part, which is congenital and arises from the primordial racial exercise (phylogenetic), and the other part (ontogenetic), which derives its relationship only during the individual person's life.

The congenital mechanisms are found in the nervous system of the embryo and predominate in the sympathetic system and in the medulla and pons. The latter centers correspond to Hughlings-Jackson's lowest level, in his three-level theory and control the simple reflex movements.

The Infant at Birth.

[2]A study of the infant at birth shows that it is a being still very different from the adult in the structure and composition of its organs as well as in the relative proportions of the members of its body.

The data for the study of new born infants is still very limited beyond that of the bare measurement of length and weight.

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[1] Edinger:
[2] Am. Jour. of Obstetrics, Vol. XXXVII, 1898. Dr. Wilson.

[1]The length of the infant at birth is about ⅓ of that of the adult. The average length has generally been taken as 50 centimeters (19.68 inches) for males and 49.50 centimeters (19.48 inches) for females.

The normal range of boys in height, as shown by the Report of the Anthropometric Committee of the British Association for the advancement of Science, is from 15 to 24 inches and of girls is from 16 to 23 inches.

The weight of an infant at birth is about $\frac{1}{19}$ of the adult weight. The average weight of a healthy child born at full time is 3,333 grams (7.3 lbs.) for males and 3,200 grams (7.1 lbs.) for females.

Again stating the figures of the Anthropometric Committee the boys range in weight from 3½ to 11½ lbs., and the girls range from 4½ to 10½ lbs. The report of the committee is based upon the measurements of 451 boys and 466 girls in London and Edinburgh hospitals and represents largely the measurements of the lower and middle classes of society. The parents were English and Scotch and represented city and country people. The measurement of the length was taken in a recumbent position and the weight without clothes.

Relative Proportions of the Parts of the Body.

While there are very great individual differences in infants in their stature, there are certain proportions which are maintained at all periods of growth between height and width. According to Dr. Uffelmann,[2] in the normal child, the measurement across the shoulders should equal about ¼ of the length of the entire body. An important difference is disclosed between boys and girls at birth. In stature and weight the girls are nearest the average type; in form the boys' shoulders and hips measure the same across; in girls, the shoulders measure a little less.

The following tables are given to show the relative increase of the different parts of the body at various periods of growth. Zeising's measurements represent a general law of proportion of the normal child, the measurements are taken from the crown to the hip and from the hip to the heel. At birth these measurements are about equal. Letting the whole length from head to heel be represented by 1,000 in each case, the relative length will be expressed as follows:

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[1]Vierordt K.: Anatomische, Physiologische und Physikalische Daten und Tabellen.

[2]Dr. Uffelmann: Domestic Hygiene of the Child, p. 7.

[1]Birth	$\frac{500}{500}$						
1 year	$\frac{478}{522}$	Increase of lower limbs			$\frac{22}{1000}$	in one year.	
2 years	$\frac{457}{543}$	"	"	"	$\frac{21}{1000}$	"	"
3 years	$\frac{439}{561}$	"	"	"	$\frac{16}{1000}$	"	"
5 years	$\frac{415}{585}$	"	"	"	$\frac{12}{1000}$	"	"
8 years	$\frac{397}{603}$	"	"	"	$\frac{6}{1000}$	"	"
13 years	$\frac{382}{618}$	"	"	"	$\frac{3}{1000}$	"	"

Growth in length of parts of body according to Liharzik's table.

[2]Representing length at birth by 100.

	Birth.	End of 21 month.	7⅛ year.	Adult.
Head,	100	150	191.7	200
Forehead,	100	114	150	157
Lower portion of face,	100	200	250	260
Neck,	100	500	700	900
Chest,	100	186	300	314
Abdomen,	100	160	240	260
Leg,	100	200	455	472
Arm,	100	182.5	325	350
Upper,	100	183	328	350
Lower,	100	182	322	350

The proportions of the infant's body are very different from those of the adult. The new-born has a very small and narrow thorax compared with the abdomen, and the pelvis as a region scarcely exists. The whole trunk thus assumes an oval form with the small end toward the neck.

[3]The anterior diameter of the thorax at birth at the level of the 2nd costal cartilage is as 2 to 3, while in the adult it varies from 1 to 2½ or 1 to 3. The sternum is relatively smaller than in the adult male, but not very different from some very small breast-bones which are occasionally found in women. The shoulders are very small, which make the chest appear quite different. The pelvis is so small that it forces the pelvic organs of later life more or less into the infant's abdomen.

Composition and Structure of the Body.

Bones. The composition and structure of the infants' bones are very different; the bones are softer and more vascular, the marrow is vastly more dilated with blood vessels. An ex-

[1]Gerhardt: Handbuch der Kinderkrankheiten, pp. 267 and 269.
[2]Gerhardt: Handbuch der Kinderkrankheiten, p. 272.
[3]Dr. Rotch: Pediatrics.

tremely important difference is noticed between the spine of the new-born and the adult. In the infant the spine has little bone and much cartilage and fibrous tissue, making it light and flexible. The movements in the spine at birth are remarkable. Dr. Rotch ovserved that the spine of a child at birth, the abdominal visceral having been removed, could be bent easily so that the head touched the buttocks. The middle part was most flexible, the lumbar region seemed to be more pliant than the cervical. The lateral motion was quite free, though not without some torsion.

Curves. The spinal curves present an interesting and important condition.[1] In the infant, the whole dorso-lumbar region is concave forward, presenting one continuous curve from the neck to the sacrum, instead of the alternating convex curve forward in the region of the neck, a concave forward in the region of the chest vertebræ, succeeded by a convexity forward in the vertebræ of the loins. The adult vertebral column presents two sets of curves; the primary or dorsal and sacral curves which are present in quadrupeds, with them the human infant begins its independent existence, and the old man takes themto his earthly abode; and the secondary or cervical and lumbar curves. These secondary curves, says Dr. Turner—"are the characteristic spinal curves of man." But Professor Cunningham noticed them in the chimpanzee and also in some quadrupeds (*e. g.*, bear). This plainly indicates that the secondary curves can be associated with the upright position.

In process of development, as will be shown in the subsequent chapters, there are three distinct stages in which the spinal column assumes a characteristic curvature. First the natural continuous curve at birth. Second the curve which appears in the cervical region when the infant has learned to sit and to support its head erect upon the trunk. Third the additional dorsal and increased lumbar curves which make their appearance when the child is able to stand and walk erect. These characteristic curves may even be produced in an infant when it assumes different positions. When it is lying in a normal position the spinal column presents the long convexity, if the head is thrown back there appears a slight convexity in the neck, if in addition the legs are drawn out the lumbar region will spring forward. The latter positions are not, however, natural in the infant.

The relative lengths of the different curves are different in the infant compared with the adult. The following tables from Aeby and Cunningham will clearly show the ratios.

[1] Nature: Vol. XXXIII, p. 378, 1886. Report of Brit. Assoc. for Adv. sc., 1897, p. 771.

Relative lengths of adult spinal curves according to Aeby. Total length=100.

	Cervical Region.	Dorsal Region.	Lumbar Region.
Females,	21.5	45.7	32.8
Males,	22.1	46.6	31.3

Cunningham's ratio from 6 males and 5 females.

Females,	21.6	45.8	32.8
Males,	21.8	46.5	31.7

Relative lengths of spine curves according to Aeby's measurements of 5 and Cunningham's measurements of 3 infants.

Aeby,	25.6	47.6	26.8
Cunningham,	25.1	48.5	26.4

Other measurements of the lengths of infants' spines from the head to the sacrum.

		Absolute Length in m. m.				Rel. Length. Total=100.		
Observer.	Age of Infant.	Cerv.	Dorsal.	Lum.	Tot.	Cerv.	Dor.	Lum.
Rasenel,	3 mos.	50.	100.	58.	208.	24.	48.1	27.9
Aeby,	6 "	52.5	103.	60.	215.5	24.3	47.5	27.8
Aeby,	6 "	53.5	107.	61.	221.5	24.1	48.6	27.5
Dwight,	10 "	61.	125.	77.	263.	23.2	47.5	29.2
Rasenell,	2 years,	70.	140.	90.	300.	23.3	46.7	30.
Aeby,	2 "	79.5	153.5	98.	331.	24.	46.4	29.6
Dwight,	3 "	78.	162.	101.	341.	22.9	47.5	29.6

The table, if continued, would show that after the 5th or 6th year the proportion remains about constant.

In spite of the individual variations and personal equations due to measurements of the different men, the tables show a marked uniformity. There is, it appears, a fuller development of the upper part of the skeleton at birth than the lower.[1]

The infant's spine thus approximates that of the quadruped until it attains the age of a year or sixteen months, which is the usual so-called creeping stage. At the time when the hips and the knee-joints are completely extended and gradually draw the leg into line with the thigh the alternating series of curves in the spine appear. In this position the center of gravity is brought directly over the base, which enables the being to stand and move about on two feet with the greatest ease and the least expenditure of energy.

Muscles. The muscles of the infant are very small and soft and not until the sixth month do they become firm and resisting. Certain muscles are more highly developed at birth than others. Thus a noteworthy difference is observed between the muscles of the arms and the legs. Although the gastro cnémius

[1] Rotch: Pediatrics, p. 56.

and the soleus muscles are developed sufficiently in body to form the calf of the leg, and the gluteus maximus is enlarged into the buttock, proportionally and in function these muscles are in a very rudimentary state compared with the muscles of the arms.

Dr. Robinson[2] found that in the case of sixty infants under one month of age, there was an exceedingly strong grip of the hands. He found that within one hour after birth they could hang by their hands onto the finger or stick ¾ of an inch in diameter, sustaining the weight of the entire body for a period varying from two seconds to one minute. Twelve out of the sixty could hang suspended ½ minute and four nearly a minute. This strength of grasp increased very rapidly after four days; nearly all ½ minute at that time. The faculty apparently attained its maximum development at two or three weeks, several children hung suspended over 1½ minutes, 2 hung a little over two minutes and 1 hung 2½ minutes. During that time of suspense no sign of distress or pain was evinced, no cry was uttered until the grasp began to give way.

This experiment shows that the hand and arm are developed functionally at birth, and the proportions are in striking contrast with the flexed position of the foot and thigh. The picture of a suspended infant reminded Dr. Robinson of a favorite chimpanzee "Sally" in the zoölogical garden.

The muscles of the neck are also in a rudimentary state of development; unless supported the head rolls off the infant's shoulders like a ball. The head can be rotated through an arc of 90° even without using the joint between the atlas and axis. The remarkable strength of the flexor muscles in the infant's body in comparison with the flaccid and feeble state of the entire muscular system is a striking phenomenon whatever may be its explanation.

Surface Anatomy.[3] Another exceedingly important difference between the infant and the adult will appear in a study of the surface anatomy of the spine. In the adult, especially in the male where the muscular system is well developed, there is a depression wherever the skeleton shows a prominence owing to the attachment of the muscles. The skeleton shows a ridge of spines in the middle line of the back, with a depression on either side; during the normal development of the muscular system there is a median furrow formed by two large masses of muscles in which the vertebræ appear prominent. In the infant this is not the case except in the neck. The back is rounded, later devel-

[1] Huxley: Anatomy of Vertebrate Animals, p. 414. Rotch: Pediatrics. Turner: Report of Brit. Assoc. for Adv. of Sc., 1897, p. 768.
[2] Nineteenth Century, Vol. XXX.
[3] Rotch: Pediatrics.

opment flattens the back and brings the spinous processes into prominence without the marked median groove, this appears only when the muscles of the back become fully developed. The laminæ, in the infant, look more directly back, and their presence in the median line is marked by knobs and ridges very different from the spine of the adult. Little change takes place in the appearance and proportions of the infant spine up to 18 months, but at three years the adult condition is very markedly approached.

Early Movements. If we compare the new-born human infant with young of other vertebrates generally, we find also a striking difference in its capabilities of assuming the characteristic attitude of its specie. The fish assumes its position and moves off in its element as soon as hatched; the chick can stand upon its feet immediately after it is liberated from the shell; the calf or colt follows its parent a few hours after birth. But the infant is most helpless of them all. The early movements of the quadruped are directed toward the end making for its existence. The movements of the human infant are vague, stretching, reflex actions, entirely purposeless, usually performed in a jerking manner, except in some cases the hand after several random attempts accidentally finds the mouth. There is no co-ordination of movements in the infant, but the movements are entirely spontaneous, arising from individual centers without any order or time of action so far as known, and not determined through the senses. Dr. Mumford[2] concludes that these spontaneous movements are not determined by forces in the environment, so far as we can see, but that the nerve centers which produce them act separately and respond as such to a specific stimulus—a reflex action; if you tickle the sole of the foot the member is withdrawn, place the finger in the palm of the infant's hand and the fingers close about it.

A further study of the movements of the infant, especially the movements of the limbs, shows how entirely purposeless they are. After a time these spontaneous movements diminish and disappear entirely or become transformed into surviving movements.

Dr. Mumford holds that, though these early infantile movements are aimless so far as the individual performing them is concerned, they are not necessarily meaningless as regards the development of the race of which the individual is an off-shoot. He believes that it is quite probable that these movements are vestiges of functions of the limbs which were of prime importance to the members of the race at another and an earlier period of its growth; but that they began to lose their prime

[2] Brain, Vol. XX, p. 290.

importance and consequently their full development when the fore-limbs of the race gradually acquired other and higher functions. The theory is suggestive and ingenious; but it is only suggestive. In the light of the preceding investigations let us turn to the returns of the topical syllabus. Although limited in number, the returns were quite full in detail and also unanimous in the conclusions based upon actual observations.

TOPICAL SYLLABUS.

STRAIGHTNESS AND UPRIGHTNESS OF BODY.

This circular seeks information from those who have access to children on any or all of the following points which are to be co-ordinated in a study of the many stages by which an infant acquires its power to get into and to maintain its upright position.

Name of observer. Age of child.
Date. Sex.
Time since observation was made.

1. *Measurements.* Arms-length; size above elbow; below; Legs-length; size above knee; below. Measure length of limbs from body to tips.

2. *Arms.* Are fingers bent waking; sleeping; clenched waking; sleeping? Are wrists bent; elbows; shoulders? Do arms lie toward front; side? Are movements of arms toward front; side?

3. *Chest.* Does chest grow flat; deep front to back? Do shoulders grow apart; together; high; low; square; sloping? Do shoulder blades grow apart; together?

4. *Legs.* As child lies on its back are legs bent at hips; knees; ankles? Is the sole of foot turned inward; outward? Are feet turned up; down? Position of toes—bent { up; / down; straight; used as fingers? Motion of legs front; side?

5. Describe first efforts to sit up; (a) how propped up; (b) in what direction is the body most apt to tip over; (c) does the child reach best front or sideways?

6. Describe the process of getting the head upright or balanced on the neck; its rolling off; learning to save the head from bumping when it tips over, saving a bump by hands and arms.

7. Describe early uses of leg and feet that anticipates standing and walking; as rhythmic moving, kicking, pushing feet against a vertical surface.

8. *Creeping.* (a) First efforts to turn over on the belly, to get head up; (b)to prop up front part of body with hands; describe any and every kind of creeping or locomotion before the upright position; (c) writhing along worm-like; (d) hitching in sitting position with one or both feet or alternately; (e) getting and going on hands and toes, elbows and feet, hands and knees, knees and elbows; (f) in progression how do the limbs act, one side together as in rocking limbs at opposite corners of the body together, or in what order, using the following

ra
ll
la
rl

e. g., to signify first the right arm, the left leg, the left arm, and last, the right leg. If ra and ll act simultaneously, place them on the same line.

9. Describe exceptional modes of progress fully, *e. g.*, rolling, going backwards, on one side, swimming movements, etc.

10. How do children first learn to go up and down stairs, get off of a bed, a chair, and any other things involving change of verticality of body.

11. First efforts to stand, in detail; (a) how made, beside or holding to what; (b) conscious or unconscious; (c) what effects on breath, gesture, feeling, etc., of first successful effort; (d) effect of falls.

12. *First steps.* (a) Are they beside walls or how; (b) first steps alone and unsupported, conscious or unconscious; (c) after the first step, and confidence is acquired do the children you know tend to walk too much; (d) effects and dangers of fatigue; (e) of illness; (f) is there a marked increase in size and fullness of legs at this time; (g) what new propensities as that to run away, more use of hands; (h) is there danger of prematurity or postmaturity in walking, should adults help? Why? Why not?

13. *Reversion.* When does child revert to creeping after he has learned to walk; when fatigued; in a hurry; excited; after sickness; after fall? Why? Revert to early manner of creeping; later?

Miscellaneous. (a) Does the spine hollow to co-operate, as angle at hip, straighten out; (b) give illustrations of children's propensity to climb; (c) describe increasing power of balance, power to stand on one foot, age at first jump, run, hop. (d) have you noticed any changes in health, appetite, circulation, temper, spirits or anything else your thoughts might be connected, as cause or result of learning to walk, sit, or any other stages.

Please write out fully any peculiarities the child may have.

Send returns to

G. STANLEY HALL,
or A. W. TRETTIEN.

CLARK UNIVERSITY,
Worcester, Mass., Jan. 26, 1900.

I. The measurements under number one were made by the writer under as nearly uniform conditions as possible. Although the number of measurements of individual children was limited, the extremes appear, so that in general they give an index of growth.

The figures given here are the general averages and extremes, representing corresponding measurements of the arm and leg. In each case the measurement of the arm is represented by 100.

Average of measurements of males at birth.

Length of arm and leg,	100 : 134.
Circumference of limbs above knee and elbow joints,	100 : 146.5
Circumference of limbs below knee and elbow joints,	100 : 115.

Average of measurements of females at birth.

Length of arm and leg,	100 : 124.
Circumference of limbs above knee and elbow joints,	100 : 143.5
Circumference of limbs below knee and elbow joints,	100 : 114.5

Extremes in measurements of the length of limbs.

Males at birth.		Females at birth.	
Shortest,	100 : 105.	Shortest,	100 : 116.6
Longest,	100 : 150.	Longest,	100 : 137.

The tables of the Anthropometric Committee show that males at birth are a little taller and heavier than females, it also shows that there are greater extremes among males than among females. The figures presented here clearly show the same development with regard to extremities. Males at birth average a greater length, their lower extremities are proportionately longer, but they also present greater extremes.

II. *Arms.* The returns represent observations upon 182 infants; 93 males and 89 females. The results may be tabulated as followed, expressed in per centum.

Fingers.	Males.	Females.	Total Average.
Clenched	83	87	85
Bent	12	4	8
Straight	5	9	7
Wrists—Of the 109 returns, 51 were observations of males and 58 females.			
Bent	69	65	67
Straight	31	35	33
Elbows—110 observations; 53 males, 57 females.			
Bent	100	96	98
Straight	000	4	2
Shoulders—58 observations; 27 males, 31 females.			
Bent	66	68	67
Straight	34	32	33
Arms—98 observations; 47 males, 51 females.			
Lay front	98	92	95
Side	2	8	5

The returns of Number 2 show that the arms lay forward from the shoulder, the movements are toward the front in 97% of the 96 observations recorded, only 3% found it difficult to move toward the front and easier toward the side. The elbows and fingers are bent in a large majority of cases; of the 110 observations made, there were found four whose elbows were straight and these were all females. In the case of the wrist there is a difference, 67% of the 109 observations made show the wrist to be bent. Thus the arm and hand tend to retain the prenatal position for some months after birth. This is especially noticeable while the infant is asleep and the limbs assume the position which is most natural to its organization.

The arms are often folded over the chest as they were before birth.

The hand at this time furnishes an interesting study of reflex action. The fingers close firmly on any object placed in the palm of the hand. Miss Shinn noticed that an object placed in the hand was seized and carried to the mouth long before purposive movements had developed. The spontaneous movements are almost constant in some children when awake and in others when asleep. They occur as slow and apparently irregular with alternating periods of rest when the movement ceases or is inhibited by some other form of movement. Dr. Francis Warner[1] observed that the movement of the fingers may be temporarily arrested by a bright object before the eyes or a sudden sound; this arrest, after many repetitions, may be followed by a new series of movements occurring upon less and less stimulation and with increasing quickness and accuracy as time goes on.

An interesting chart has been prepared by Dr. Warner tracing these irregular spontaneous movements of an infant's hand for fifteen minutes when 9 days old. The chart also shows the inhibition of these movements by sight and sound. Miss Shinn[2] observes that while the spontaneous movements may be inhibited by co-ordinated movements from the first to the third month after birth when the child is awake, they may persist in sleep for several years.

Dr. Mumford[3] has carefully studied the development of the independent action of the thumb and the power of opposing it to the rest of the hand. During the early weeks the thumb appears to be a quite useless member, the hand ignores it in its grasping. Small objects are held between the fingers or between the fingers and the palm with the thumb either turned in with the object or extending outside. Only after two or three months does the thumb reverse to oppose the hand. Dr. Preyer found this development appearing the 12th week, Miss Shinn the 9th week and Dr. Mumford the 14th week. With the fuller development of the thumb appears the searching and investigating movements of the index finger. The finger is pointed at objects or carried in advance of the hand as a scout sent out to explore a new and strange environment.

1. Fingers.

1. F., 4 wks. She kept her fingers clenched both awake and asleep, but more especially while asleep.

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[1] Journal of Mental Science, Vol. XXXV, No. CXLIX. New Series, No. 113, p. 37.

[2] Shinn: Notes on Development of a Child, Plates III and IV.

[3] Brain, Vol. XX, p. 303.

2. M., 3 wks. His fingers were clenched both wehn awake and asleep.
3. M., 2 wks. When awake his fingers were bent, but when asleep his fingers were clenched.
4. M., 2 wks. The fingers of the baby are not clenched, but only a little bent when awake, but when asleep they are clenched tight.
5. M., 5 mos. The fingers are bent and in constant motion when awake and asleep.
6. F., 2½ mos. Kept her hands closed when awake and open when asleep.
7. M., 2 wks. The fingers were clenched when awake but clenched tighter when asleep.
8. M., 3 wks. When awake the fingers are not clenched, when asleep the fingers are clenched.
9. F., 3¼ mos. The fingers are bent loosely, and the fourth finger sticks out straight.
10. M., 4 wks. During the early weeks of life the fingers are clenched when awake and bent when asleep.
11. M., 4 days. Fingers were clenched when asleep and bent when awake.
12. M., 3 wks. If disturbed in sleep the little fingers would spread out like a fan.
13. F., 1 wk. The fingers are slightly turned at the tips.
14. M., 6 wks. When awake the fingers are moving inward, he puts his hand out straight with his fingers as far apart as he can. When asleep the fingers are bent.
15. F., 8 wks. The baby's fingers are generally tightly closed when awake, except when in pain they are clenched.
16. M., 4 wks. The fingers are clenched so tightly that the nurse must pry them open in order to wash the palm.

2. Arms.

1. F., 4 wks. She would always keep her elbow bent and would seldom attempt to hold the arm straight.
2. M., 2 wks. The wrists are but slightly bent; the elbow is considerably bent.
3. M., 5 mos. The wrists are bent inward.
4. M., 3 wks. The wrists and elbows are bent.
5. F., 3¼ mos. The arms are bent from the elbows when asleep and crossed over the breast so that the right hand is below the left.
6. M., 3 wks. The movements are toward the front usually, the little hands double up when resting on the chest.
7. F., 1 wk. The little hands are clasped over its chest, if it has its little shawl on it will also clasp it in its arms.
8. m., 6 wks. When asleep the arms are folded across the chest so that the left hand is near the mouth and the right a little below it.

III. Chest.

The movements of the infant's arms are limited to the plains extending forward from the body. The shoulder-joint is most free, the elbows and wrists are quite rigid, and it is only gradually that the infant acquires the ability to move its arms sidewise or to move its joint freely.

The answer to these conditions will appear in part from a study of the chest and its development. A study of the returns

shows that the growth of the chest continues along two lines—in depth and sideways.

In the prenatal stage the position of the arms is across the chest, the shoulders are brought forward, the shoulder-blades separated, giving the whole body a round appearance. As growth continues after birth the tendency is to push out along the line of least resistance, the sternum is cartilaginous, consequently the chest walls are pushed forward and a little side of the median line, the body grows in depth from front back. This development carries the shoulders back and up or back and down, the shoulder-blades approach one another, the back becomes straight and the shoulders square or sloping.

One observer says—that "at first the shoulders grew up, then after 3 mos. they gradually grew sloping." Another says—"Florence's shoulders grew very square; the shoulder-blades grew so close together that the whole body was pulled back." This is the natural course assumed by the body as it changes its position from the curved or stooping attitude to the erect. An observer who noticed the fact and not the cause, says: "The shoulder-blades grow together, for as the baby learns to straighten up, she throws her shoulders back." Another manner of growth is that in which the chest grows in width and apparently becomes flat, in this case the shoulders and shoulder-blades are crowded apart. The back keeps pace with the chest. Out of 79 observations made 37% of males and 53% of females developed sideways, their chests becoming flat and broad. With this development the shoulder is brought back, so that a wider range of movement becomes possible, and one great advancement toward adult movements is made.

1. Arm Movements.

1. F., 4 wks. All her movements were more toward the front of the body, and only gradually off to the side.
2. M., 3 wks. The arms move up in front first.
3. F., 3 mos. Her arms tend to lie more to the front of the body and the arms move forward.
4. M., 4 wks. Movements of his arms were in front of the body when lying on my lap.
5. M. The child does not make movements toward the sides until about 9 months old.
6. F., 5 wks. If the child wishes to reach sidewise from its body it will turn its body to face the object and then extend its hand.

2. Chest.

1. F., 3 mos. When Magdelena was small her chest was very deep, but after she was about 3 mos. old her chest seemed full.
2. M., 6 mos. The baby seems to be growing thicker through, the shoulders are growing more square.
3. F., 3¼ mos. The chest grows from front to back in depth. Her shoulders grow square and high.
4. F., Birth. The chest grows sideways, the child grows broader.

5. M., 3 wks. The chest develops sideways, the shoulders grow apart.

6. M. The early year of Herbert's life his chest grew in depth; his shoulders grew apart; his shoulder-blades grew together; and his shoulders grew low and sloping.

IV. Leg.

The prenatal position of the feet is maintained after birth for some weeks, up to the time the limbs prepare for the creeping and walking stages. The legs are bent at the hip-joint bringing them forward. The knees are bent and usually turned out a little; the feet cross, with the right foot laid over the left, and are turned up with the soles toward the median line. The toes are usually curled under toward the sole of the foot; occasionally one is found where the toes spread apart and extend out straight from the foot. Often the great toe is found to be far separated from the other toes, with the tendency to oppose it to the sole of the foot. The greatest freedom of movement at first occurs at the the hip-joints, with less at the knees and little at the ankle-joints. The movements of the legs, as of the arms are front and back, rarely toward the side. It is a very frequent occurrence to use the feet as hands in seizing objects and carrying them forward to the hands and mouth, the storehouse of all captured prizes. Several instances from observers will illustrate this. One speaks of the spontaneous movements of the opening and closing of the toes, similar to the movements of the fingers, when the child was awake and asleep. Another states that the toes would seize and hold a pencil or other object of proper size and hold it so tight that it was difficult to remove it, or it would seize and hold the edge of its shirt as if it were using its fingers. Another child would work its way toward the foot of its couch until its feet touched the perpendicular round sticks at the foot of the crib, the foot would then attempt to grasp the sticks, finding them too large for its grasp it would move its foot from one to the other until it came to the central wire which it could encircle and this it seized and held firmly. Another observer states a peculiar tendency in a child 7 months old,—if the child saw an object she wanted, which could not be reached with her hands she would reach for it with her foot, if successful, she pulled it along with her foot until it was near enough to reach it with her hand. It is not necessary to multiply instances any further to remind one of the cunning devices of the little anthropoids in the menageries reaching for their peanuts.

1. M., 10 mos. When laid on back the feet are crossed and turned upward. The motion of the legs is toward front, side movement was developed at about the 9th month. The child was called "Little Turk," from the position of his legs.

2. M. 5½ mos. When Robert lies on his back his legs are bent and

he immediately raises them forward to seize with both hands, and carries them to his mouth. The knee is bent, and with the sole of the foot is bent inward; the ankles are bent out; the foot is bent downward; the toes are curled under. The motion of the legs is forward. He grasps the stockings with his toes.

3. M., 9 wks. The great toe is separated from the others and is moved more.

4. F., 2½ mos. When the child lies on its back the legs are curved and crossed. They are not mobile, and the mother has hard work to pull them straight. The toes are spread. The movement of the legs is forward at first.

5. M., 2 mos. The legs are curved inward; the feet are turned downward; the toes are close together and turned backward. The motion of the legs is decidedly toward the front.

6. F., 3 mos. When lying on her back the legs are bent at the knee and at the ankle. The soles of the feet are bent inward and the feet are turned upward. The toes are spread apart.

Treatment of Infants among Primitive Peoples.

We have now arrived at one of the most interesting points in the process of development of the child, that is from the time when the head is balanced upon the summit of the spine and the body begins to rise into a sitting position, to the time that the child takes its first steps. This period is important, for the ignorance of parents and nurses have caused many a child to spend its life a poor deformed creature at the mercy of society. To know whether it is normal for a child to develop the power of co-ordination and thus to sit or stand alone, to understand the childish actions, whether in creeping or walking, is a lesson which has taken the human race a long time to learn; and certain parts of it, even in civilized lands, have not yet learned the lesson.

It will not be amiss here to cite several instances of practices among some of the primitive as well as customs among civilized people to which infants are subjected. Dr. Ploss[1] has said that "the manner of treatment of the child is a very accurate standard of the stage of civilization of a people." No truer words than these were ever spoken. Superstition and ignorance are the two mistresses who hold the keys which unlock the treasure house and set truth free. They are also the stumbling blocks in the way of progress for individuals and races.

Primitive as well as civilized people have looked upon infant development as an unnatural process. They have had an entirely false conception of the natural development of the body and its various organs and their functioning at a proper time, if not interfered with. If left to nature, according to these people, the body would not assume a proper attitude, therefore they seek to aid the natural growth by mechanical treatment of body and limbs to bring about their ideal forms, and it is need-

[1] Das Kind, Vol. II, p. 50.

less to say that such means operate directly against the end sought.

Dr. Ploss[1] tell us that the Wahumba and their allies, the Wakuafi in East Africa, have a practice of binding the lower part of the leg of the infant, from the ankle to the knee, with a bandage which remains until the infant grows strong enough to raise its body and sit up. By this compression they seek to interfere with the development of the calf of the leg, which, according to their notion, interferes with fast and continuous walking. The Maori women of New Zealand daily put all joints through a process of bending, the fingers are drawn out and the limbs stretched to make them limber. Certain tribes of Australia exercise the limbs of the new-born in the following manner:— A roll of muka is tied quite tight around the knee of the child in order to give it straight limbs, its arms and legs are drawn out daily, while the hands and fingers are bound firmly to keep them in the proper position. The soft flesh is often so compressed underneath the bandage that it is forced out at the sides. These people place much significance upon this shaping of the body, and the mother is considered as neglecting the sacred duty toward her child, if she does not, by artificial means, have the calf of its leg conform to the statutory provisions.

It is the custom of the Kalmückin to place a definitely formed wedge between the legs of the child in order to bend them according to the prescribed custom that they may be the more properly adjusted for riding. Certain Armenian people, after the 15th day of an infant's birth, thoroughly stretch the shoulders daily, pull out the legs and arms, press each muscle and joint, raise the head and stretch the neck to give it its proper length, or the child is suspended by its feet and allowed to swing back and forth several times like a pendulum, then it is turned about end for end and the process repeated. The Russians press every muscle and member of the body at birth, on the second day the infant is rubbed and whipped with a bundle of birch twigs, then it is snatched up quickly by the feet in order to properly adjust the members of the body.

Even the Germans had an early custom which is practiced in some sections of the country to-day, where the pressing and stretching process was employed to beautify the body. In modern times in Europe and America, the horse-collar, a sewing-machine cover and other means are employed to aid the infant in sitting up, or it is tied in a chair and allowed to remain so that the weight of the head and trunk becomes too great to be supported by the soft and growing bones. Or children are encouraged to walk by putting them into a walking chair before the

[1] Ploss: Das Kind, Vol. I, p. 334.

limbs can support the weight of the body, thus endangering their normal development. Our age of civilization is not yet freed from the results and methods of infant torture which were inflicted upon it for both their artistic effect and also to hasten the child's normal development. From these illustrations we see that there was lacking in primitive people and even among some of the civilized people to-day a proper appreciation of the normal development of the child. And one of the greatest drawbacks of a proper appreciation is a lack of precise facts concerning the healthy child.

During the early months some people believe that the child must learn to "sit up," and consequently they carry it erect on their arms during the first weeks of its life, later it is placed in an erect attitude upon the floor or in a chair. The chair was used early in history as a means of teaching the child to sit. The early Romans used it; it was found in the early Middle Ages throughout Europe. Travellers[1] to different parts have found the chair among natives. In Queen Charlotte's Island, voyagers found the native women using a small chair made of three pieces of bark fastened in a convenient manner. In this chair the child was placed, after it was rolled in the skin of a wild beast and fastened securely. Here the little thing was fed and rocked to sleep. Among the Esquimos on the Yukon, Mr. Whymper saw small chairs made of birch bark, in these a mossy seat was made and the little fellow was securely tied so that the mother could carry the chair and child wherever she pleased. The Chinese and Dutch have gone a step further and have combined the sitting with walking and have placed the child in a chair with rollers so that as the little one begins to walk it can push its chair with it, they have also added a table with a complete outfit of playthings and even school work is here introduced.

The chair, however, is an article not yet known among many primitive peoples. They let the child wallow upon the ground and let it learn according to its own unfolding strength and by its own intuition and observation. This is not only true of the primitive people but also of many of the Oriental who sit upon low cushions or squat upon the ground with their feet under them. And it has been observed that when the adults of a race assume these postures in sitting, the children learn the same by imitation. Examples may be cited upon this point from travellers' records. Thus, the Motu, a tribe in New Guinea, have a custom in which the men, in sitting, usually assume the squatting posture placing the soles of their feet firmly upon the ground and rest the buttock upon the heels. The women and children

[1] Ploss: Das Kind, Vol. II.

usually sit down upon the ground with their legs extending before them. The Popuas and Malays, the Negrites and Filipinos, assume similar positions when resting. As the children naturally follow and imitate the mothers earlier than the fathers they sit as the mothers do. At first on the mother's knees resting their backs against her body, then with increasing strength they assume the positions alone.

Locomotion of Infants of Primitive People.

Travellers have also noticed a similar peculiarity in the manner of locomotion of the children of certain tribes which are characteristic. The Arabian children as well as those of some of the tribes of Africa have a different manner of creeping from the European children. Instead of creeping on their hands and knees as the little Anglo-Saxon is wont to do, they sit up and slide along by hitching. Dr. Livingstone says in his "Last Trip through Central Africa," "The Manyuema children do not creep like European children upon their hands and knees, but begin their locomotion by placing one foot forward and rest upon the other knee, usually they employ both feet and both hands, but never both knees. The Arabian children employ the same means, they move along on both feet and assist in pushing with both hands." The children of these primitive people learn to walk much earlier than do the European and American children. Dr. Gräffe observed on the Island of Samoa that children of 9 and 10 months followed their mothers with tottering steps.

The usual manner of infant locomotion among primitive people, and some Oriental, is one of several rather exceptional means employed by the children of higher civilization. Anthropology has not yet answered the cause of this difference. Whether it is due to physical structure of the body or to mental characteristics and customs. Though students are inclined to accept the latter view.

Mr. R. W. Shufeldt[1] describes the acts of an infant about 10 months old which he saw while visiting the Navajos, an indian tribe inhabiting parts of New Mexico. He had been about the huts trying to secure pictures with a camera when he saw in a path, leading from one hut to another, an infant toddling along which he believed about 10 months old. The little fellow came down the path to about 30 feet from where Mr. Shufeldt had planted his camera in readiness for this little victim. Seeing the situation, the child very cautiously left the path and was in a moment behind a sage-brush growing along side the path. From this position he peered through the leafless twigs. Mr.

[1] Nature, Vol. XXXV, 1887.

Shufeldt then tried to focus his instrument anew; while his head was concealed for a moment, the little lad ran to the next brush about 10 feet distance toward the hut he was approaching and from there, crouched down and stared like a young lynx. At this Mr. Shufeldt took his instrument and approached him in this place, but upon arising he had scampered to the next brush. Now becoming desperate, lest he should lose his picture, Mr. Shufeldt ran to the place of concealment and pointed his camera three feet from the little fellow's face. At this last resort the child stood perfectly erect and gave for the first time vent to his infantile bawl and made a desperate break for the final point of his destination as there was nothing else left for him to do. This ability and cunning was displayed by a child 10 months old.

Psychological Aspect of Spontaneous and Voluntary Movements of Infants.

During the early months of the child's life we accordingly see important changes taking place, the spontaneous movements are very gradually disappearing, and in their place appear the conscious reactions, even apparently shut voluntary efforts. This is the period of gradual transition from the racial to the individual experience. The child learns to carry its hand to its mouth, the movements of the arms and legs which were so jerky and vague assume a more rhythmic and controlled character. What changes are taking place in this transition from the purposeless to the volitional movements? Several theories have been advanced in explanation of this step. Ribot considers the acquired movements, like walking, inherited and defines inherited as something that was at some time acquired but since has become fixed and rendered organic by numerous repetitions. It is organic memory. Spaulding[1] maintained that "the progress of the infant is but the unfolding of inherited powers." C. Lloyd Morgan[2] in answer to this says, "Spaulding went too far. Such unfolding there is, but it is under the guidance of individual experience. The regular flexions and extensions of the legs, 'which appear even months before the first successful attempts to walk, when the child, held upright on the floor, is pushed forward,' are instinctive, as Prof. Preyer points out, and as Prof. Mark Baldwin has shown. But under normal circumstances the walking of the child is not solely an instinctive activity, acquisition largely co-operates. It is the joint product of instinct and acquisition." Mr. Bain[3] sums

[1] Nature, Vol. XII, pp. 507, 508.
[2] Habit and Instinct, 1896, p. 106.
[3] The Senses and Intellect, 4th Ed., p. 281.

up his view when he says—"the instinctive character of locomotion, so obvious in the inferior animals, is less apparent in ourselves, seeing that the power of walking is not possessed by us until about a year after birth. Nevertheless, there are certain strong presumptions in favor of an original endowment entering into our aptitude for locomotion." The Spencer-Bain theory attempts an explanation along the line of the current biological adaptation. As Prof. Baldwin[1] has summarized the theory—"the organism is endowed with spontaneous movements, a certain spontaneity of action which must be assumed. Certain of these spontaneous movements happen by 'lucky chance' to succeed in bringing the organism into some special adjustment, better exposed, better protection, easier function, etc.; these movements are accompanied by pleasure. The pleasure lingers in the consciousness of the creature in connection with the memory of the particular movement which brought it; and the memory of the pleasure serves to incite the creature to execute the same movements again, whenever the external conditions present themselves. The repetition thus secured serves to fix the new adjustment as a permanent acquisition on the part of the organism." Here we have the assumption of consciousness with pleasure and pain and the power of the creature to associate the stimulus which produced it with the movement which will carry it toward or from the object which produced the sensation. And Bain adds—"Here is assumed the law of pleasure and pain. Pleasure is accompanied by heightened nervous energy, which nervous energy finds its way to the lines of communication that have been opened up by the lucky coincidence." Prof. Baldwin[1] now goes a step farther by what he calls the "Motor Excess," and says that pleasure and pain can be agents of accommodation and development only if the one, pleasure, carries with it the phenomenon of 'motor excess,' the other, pain, the reverse. Then he asks why certain movements which are accidentally more adaptive than others give pleasure. And his answer is, that the movement in itself is not pleasurable, but it is only pleasurable in so far as it gets something for the organism. Something which ministers to its life, that gives it pleasure.

This view assumes, then, that "the organism begins with a susceptibility to certain organic stimulations—food, oxygen, etc.; these when present give pleasure, the pleasure is, physiologically considered, a heightened vitality in the central nuclear processes; this heightened, central vitality issues in a motor excess discharge; from the resulting abundant and varied movements of this excess discharge those are selected which bring

[1] Mental Development, p. 181.
[1] *Ibid*, p. 189.

more of these vital stimulations again; and these finally keep up the vitality of the organism, and by the repeated excess movements, provide for constantly progressive adaptations."

This summary gives us the evolutionary view of movements. Biologically speaking, movement is controlled by the "principle of auto-differentiation." The organism possesses the power of developing in a definite direction and into a definite end product. This power is potentially inherent within the smallest germ. Each living organism carries with it as an essential attribute movement. And movement which is a concomitant of the development of the organ. The so-called "spontaneous movements" of the lower creatures and the human infant are organic. As the nervous system develops, forming co-ordinations of the different centers and the movements become more rhythmic and less spasmodic, as consciousness unfolds, these movements, as any other stimuli produce certain psychic states which can be reproduced at will and the once spontaneous movement becomes voluntary. Observations show also that a successful reproduction of the co-ordinated movements in the infant produce pleasure and it wills to repeat a movement again and again. There is, then, in the child a physiological development as well as a psychic unfolding which bridges the racial and individual experience.

Let us observe the facts as they appear.

Attempts of the Infant to Rise Up.

The first tendency in the child to rise into a sitting posture is manifested in its struggling when it is put down into its crib, after it has been carried in the arms, during the early months of life. There is an attempt to raise the head. This is due to the fact that the primitive segments of the cervical region of the spinal column develop first and precede in growth the remaining parts. The upper parts of the entire body develop earlier and consequently function earlier than the lower parts throughout the early years. The time when the infant can first raise the head varies with different individuals; some are able to hold it erect, and even balance it, at birth, but in general it is about at the the age of two or three months when the head is raised and about four or five months before the muscles are co-ordinated which maintain it erect and keep it from vascillating.

The head of the infant which rolls off the shoulder may fall in any direction; most often, however, it falls forward upon the thorax and rolls toward the side. The muscles of the neck at birth are very small, as has been indicated in the foregoing table, since the neck increases nine times its size at birth.

MOVEMENTS OF THE HEAD.

1. M., 2 mos. Head rolled off in every direction.
2. F., 1 mo. Head falls side and back.
3. F., 3 mos. Head rolls toward front and then toward side.
4. F., 3 mos. Head rolls toward one side.
5. M., birth. Lifted his head without apparent effort on the day of his birth. Seemed able to control the movements of his head from the first.
6. M., 3 days. Tried to raise head but failed. Head fell toward front.
7. M., 1 mo. Head rolled off front, then sideways.

With the ability to raise and balance the head, the muscles of the back, chest and abdomen develop so that the infant may some day surprise its mother or nurse by suddenly stiffening its neck by straining its back and seizing firmly the side of the crib and pulling its body into a sitting posture, or rising on its knees while in its bath. Very frequently this first successful rise is the result of a special and strong stimulus, such as a fit of crying, hearing an unfamiliar sound, etc., and when its feeble efforts are rewarded by success a smile of joy passes over the face of the little one.

Many children are, however, given the suggestion to rise in a sitting position by grasping a parent's extended fingers and are then pulled erect. Miss Shinn observed that as early as the seventh week, when the mother held the hands of the child in wiping her after her bath, there were slight muscular contractions, though with no intent to pull herself up, as her mother had tried to develop it by giving her a finger and pulling. When the child was three months old, she succeeded in rising up by the aid of the fingers, but immediately tipped over sideways. After that she tried twenty-five times in succession to lift herself by her abdominal muscles, but could only lift her head and shoulders. She was then stopped as she showed discouragement. The common method employed by children in sitting up when placed upon the floor on their backs where they cannot pull themselves up by their hands is—by first rolling over upon the stomach; they then rise upon the hands and knees, turn sidewise in a half reclining, half sitting position, supporting the body with one hand and finally raise the trunk into a sitting position. A rather peculiar manner is seen in Miss Shinn's niece. The child first rose to her hands and knees, then separated the knees and lifted herself backward into a sitting position, landing the child with its legs spread wide before turning out at each knee in a right angle. This exceptional sitting position was invariably assumed. The usual position for children is the simian—in which the legs are extended forward with the soles turned toward each other. After such exercises, repeated daily, children soon learn the

possibility of sitting erect and are not content to lie down when not asleep.

1. F., 4 mos. Baby could not raise itself when lying down. One day it was angry because it wanted to be taken from its cradle. It stiffened its neck, seemed to exert all the muscles of its chest and abdomen, and after falling back two or three times succeeded in raising its body into a sitting position.
2. F., 2 mos. When Mary first began to sit up she would stiffen her neck and then her back and try to balance herself in that manner.
3. M., 3 mos. First raised its head like a turtle.
4. M., 4 mos. Baby first raised its head again and again until it could raise its head and back.
5. M., 4 mos. Tried to sit up when lying on its back, but could only succeed in raising the head from the pillow. After repeated efforts it got over on its side, then it pushed itself up and rested on its arms in a half reclining position.
6. F., 1 mo. Helen tried to sit up by first taking hold of the side of the crib and then tried to pull herself up.
7. F., 2 yrs. Tried to sit up by raising her head up as far as possible without using her hands.
8. F., 2 mos. This child while lying on its back would raise its feet and head, the head in its effort to rise would bob from side to side.
9. F., 4 mos. In trying to sit up the child will first raise its head, then its back, followed by frantic efforts to rise farther.
10. M., 2 mos. In trying to sit up the baby would first raise its head, then try to pull up the body with all its might.
11. F., 1½ mos. I have seen Mary, when lying in her crib or carriage, take hold of it with her hands and try to pull herself up.
12. M. The baby was lying in its bed; it took hold of the side with its hands and succeeded in raising its head up. It would then lie back and rest awhile and soon repeat the process.

After the muscles of the neck and trunk have developed sufficiently to raise the head, the child must still learn to coordinate their movements and tension, to balance it upon the trunk. The head at first bobs and jerks from side to side, forward and back, under which conditions the infant manifests not a little interest mingled with anxiety and determination. Unexpectedly, however, the head takes a sudden roll forward and sidewise through a great part of the arc, regardless of consequences. There are as yet no compensation movements to protect it. The only way in which nature has favored the infant against serious bumps at this time is in allowing the muscles which raise the head to precede the muscles of the trunk in development. The infant makes no attempt to save its head from injury until later when it can raise its body. Then after repeated experiences are the movements of falling and the sudden stop associated, and compensation movements manifest themselves. From the returns and observations, it appears that there are three different means employed of saving the head from bumps. First, a twitching of the eye; second, turning the head in another direction to oppose the fall; and third, putting out the hand to secure the head or intervene between

it and the obstacle, thereby making a softer surface to strike. The last seems to be by far the most common.

1. M., 5 mos. Baby doesn't know enough to keep his head from bumping, just falls over and bumps.
2. F., 8 mos. First made no attempt to save the head; later it used the hands to shield the head and tried to fall on the hands.
3. M., 2 mos. If the head rolled off, or even if you lowered him quickly, he would shut his eyes and throw his hands forward to save himself.
4. M., 7 mos. Put his hand on surface against which his head might fall to save it from the bump.
5. F., 6 mos. The child holds on to the pillow with the hands to save its head from bumps.
6. F., 3 mos. After a few bumps she would put up her hand.
7. M., 4 mos. Simply lets the head bump.

In the same manner, it requires several weeks for the muscles of the trunk to develop sufficiently to balance the body in the sitting posture.

The returns show that the body falls over forward and toward either side, but usually toward the front and toward the right side. This fact shows that the legs at this time already play a little part in supporting the body as braces. In case the body falls toward the right side and a little forward we can probably see the influence of the prenatal position of the right leg, which is often raised and extended across the body, so that the position of the left leg upon the floor more firmly than the right may throw the body as it falls forward toward the right. The movements of the hand are almost entirely directed forward. The baby reaches forward, in case there is an object at the side which it wants, the body is turned to face the object, then extends its hand. In case an attempt to reach sideways is made the body is sure to fall in that direction. This shows conclusively that the co-ordination of movements takes place along a certain line and is subject to a law of development which is much influenced by prenatal conditions. At about the seventh to the ninth month the normal child has sufficient control of its muscles to enable it to sit erect without being held or fear of falling over. It cannot yet move nor does it attempt to do so. Dr. Rotch[1] says of this period of child growth "that as long as the infant can be made happy in the prone position, whether in the nursery or carriage, it is better for it to be kept in this position. When it begins to sit up during the first year the back should be carefully supported by a pillow." The hospital reports show that the manner of carrying children, as well as the means employed in teaching them to sit up, results in serious spinal deformities, as the weak, undeveloped muscles have a tendency to allow the formation of a lateral and posterior curvature.

[1] Dr. Rotch: Pediatrics.

1. F., 2 yrs. The baby would fall toward the front.
2. M., 9½ mos. The baby would fall toward the front and side, but more frequently toward the right side.
3. M., 5 mos. The child was propped up in a horse collar on the floor, it then would fall forward on its face.
4. M., 1 mo. The child was propped up with pillows, he would then try to lift his head and look around, but his head would roll off sideways. He falls toward the front and always when about to go puts out his hands and closes his eyes.
5. F., 6 mos. The baby was most apt to tip over toward the left side.
6. F., 4 mos. Mabel was taught to sit up alone by being put in a sewing machine top with pillows and blankets around her.
7. M., 2 mos. Baby was most liable to fall toward the right side.
8. M., 1 mo. The baby falls forward and almost always toward the right.

Rolling Over and Creeping.

Dr. Ploss says "the child will learn to walk by its own efforts, if, at the time it feels the increasing strength of its muscles, it is allowed to exercise its limbs upon the floor." At first very feebly it sits erect, then follow its desires to change position and reach for or move toward distant objects by getting upon its hands and knees and creeping or hitchiug along with its feet to the desired spot. Creeping or hitching is then a necessary step to walking.

The study of creeping as it appears in this chapter is based upon the returns of observations made upon 150 different children representing those of American, English, German and Irish parentage. As creeping and walking are entirely voluntary movements the individuality of the child appears very markedly.

The returns show that early in life, sometimes by the third month, the reflexes of the legs become more or less co-ordinated into differentiated rhythmic movements, which are simply alternating leg movements. They may be forward and backward or the reverse, rarely sideways. These rhythmic kicks may very early be stimulated by touching the soles of the feet to a coverlet or floor. Some children will amuse themselves for half an hour by simply repeating these alternating movements. Prof. Baldwin noticed in one of his children that alternating movements were backward but that creeping had a tendency to correct them.

At seven months the well, strong child will enjoy standing on its feet if supported. It will straighten its legs and press its feet against a resisting surface. It will jump and kick vigorously.

M., 10 mos. Baby would push its feet against the crib or pound its feet on the floor when lying down with much enjoyment.

M., 7 mos. When placed so that his feet could touch a flat surface, he would put down his feet as if trying to walk. Would also push his feet against a person's lap in standing up.

F., 3 mos. Pushed with her feet against one's body.

M., 4-6 mos. Lay on the floor on his back and kicked for 20 minutes with much apparent enjoyment.

F., 9 mos. In trying to stand, she would jump up and down on her mother's lap, and place one foot on the top of the other.

M., 6 mos. As soon as he felt his toes touching he would dance up and down. His little back would stiffen and his leg would straighten out.

The manner of turning over on the belly, preparatory to creeping, varies with different children. Some thoroughly enjoy lying on the abdomen, while others do not, one observer states that she could always stop a child from crying by placing it, when very young, across her knees. This position may have relieved a disturbed stomach or other visceral ailment. Other children may roll over accidentally and find that they can apply their hands to better advantage than when lying on their backs. Other children do not enjoy lying in a prone position, especially after they have gained sufficient strength to sit erect. They lean forward, sidewise, and turn part way, half-reclining, half-sitting. By irregular movements they assume a variety of positions. The majority of children, however, will, when placed upon the floor, after they have gained sufficient strength, roll over on the abdomen and pat the floor with the palms of their hands. When this position has been gained, children will soon learn to raise the body with their hands. One observer remarks—"when Eva first attempted to support her body with her hands she would put her little hands flat on the floor and with a great strain try to raise her body. Her first efforts failed; soon she could raise the body, but not sufficiently to straighten her elbows, and after a few moments her strength gave way and the body fell heavily."

The different means employed by children in turning over on the belly vary from the purely accidental to those which appear to be voluntary. Some roll over while trying to reach forward for an object and often manifest extreme surprise at the position, or they cry, perhaps because of the shock. Others roll over upon the side after much wiggling, and then by a sudden movement of the hand or leg roll over, or they may throw one or both legs over, thus carrying the body over upon the side. Still other children turn over from the sitting position. They first turn over on the side then upon the belly. The same method is usually employed by a child which was first successful, no matter how laborious.

Rolling Over on the Abdomen. Raises the head a little and a corresponding movement of the legs—then rolls over with one arm underneath it. After repeated trials this arm was drawn out.

Child was lying on its back, it rolled over upon its side with one arm under it. In its effort to get its hand out it rolled over on its belly. It first placed arms out at full length upon the floor.

M., 10 mos. In making an attempt to roll over he would raise his head and roll over on his side as far as possible and strain as hard as he could. He would, at times, be unsuccessful and cry.

M., 9 mos. When the child reached for something he toppled over, then in trying to get up again he props himself up, and in this manner acquired the habit of creeping.

M., 10. Put one hand on the floor and held one leg still while it threw the other over, carrying the body to the side.

F., 8 mos. When sitting on the floor, she would roll over on her side, then turn over on her belly and kick.

F., 9 mos. Put hands over to one side then turned the body after.

Creeping. From this position of sitting one of the various forms of creeping is easily employed. A study of 150 children (males and females equally divided), shows that 60% crept while of the remaining, 30% moved along by hitching, 7% by rolling, 3% by crawling, swimming, or some other means peculiar to the individual. [1]Fifty % of the creepers moved forward on their hands and knees, moving their limbs on the opposite corners of the body together. [1]Twenty % moved forward on their hands and knees but moved the limbs on the same side of the body at the same time as in pacing. Nine % walked on their hands and feet with the limbs on the opposite corners of the body moving together, except one little girl moved the limbs on the same side together. One little boy planted the feet out aside of the tracks of his hands. Twelve % (7 males and 4 females) walked on their hands and dragged the body and legs, and 6% (3 males and 2 females) crept backwards. One used his hands only in pushing the body back to the desired spot. The remaining 3% had movements which were distinct from any other or combinations of other movements of creeping, such as creeping on the hands and knees, the hands alternating and the knees moving together as in jumping; creeping by the use of both arms and one leg while dragging the other leg; or by the use of only one arm and one leg.

M., 12 mos. In creeping he used first one hand then the other, then drew up both legs together.

This child goes along with one leg out straight behind, creeps on its two hands and one knee.

M., 6 mos. He crept in the ordinary way, using the l. a. and l. l., then r. a. and r. l.

F., 6 mos. Crept on both hands and with right foot, dragging the left.

F., 7 mos. When D— sits on the floor she goes over to the right, raises herself with her right hand, then gets on her hands and knees and creeps around, making a great noise for a small child.

M., 6½ mos. James used to creep in a very peculiar manner. He only used one arm and one leg. He would rest on the other side of the body, but never use those limbs in creeping.

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[1]Boys and girls equally divided

F., 10 mos. D— began creeping at the age of ten months; she moved the r. a. and l. l., then the l. a. and r. l.

F., 10 mos. Lucy first began to creep, then walked on her hands and feet.

F., 6 mos. Walked on hands and toes.

F., 11 mos. The baby got on its stomach and with its two hands endeavored to move along, occasionally kicking slightly with its lower limbs. In moving the limbs acted alternately. One day evidently the child could not creep, in this way, fast enough to suit herself, so she very quickly turned round and by the use of her hands and by kicking her feet she pulled herself backwards.

M. The child is very fat. He does not creep on his hands and knees, but sits square down on the floor and by the aid of his hands slides along.

M., 5 mos. He would put his hands on the floor and then slide his feet out from under him toward the back.

M., 6 mos. To get along on the floor, he would sit on his right leg and rest on his right hand, dragging his left leg after him and using his left hand for propulsion.

M., 6 mos. He pushed himself backward with his hands.

The baby lay on its stomach and used her arms half bent to drag herself along.

M., 9 mos. Little Frank, in trying to move about the room, would place his hands flat on the floor just as far in front of him as he could possibly reach, then bear his weight on them and lift the front part of the body off the floor, then he would give a spring and throw his body forward. His little twin sister, Marjory, would lie almost flat on the floor and wriggle along like a worm, first to one side then to the other, with her hands in front of her which pulled her along.

Hitching. The next most common means of infant locomotion is the so-called hitching. The returns show that 30% of the whole number of children observed progress in this manner. The child does not turn over on its belly but moves in a sitting position. The movement is usually preceded by reaching toward an object desired which tends to carry the upper part of the body forward; this forward movement of the body produces its natural converse, that of drawing the feet toward the body or bracing them upon the floor; this may draw the entire body forward. Some of the variations in hitching are such as sitting perfectly erect and pulling the body forward with both heels; pushing the body along with both heels and sliding the feet forward; sitting on the left hip and using the right leg and left arm to move the body forward; using the right leg and arm to move the body and drag the other leg after; using both feet and both hands, the feet to pull and the hands to push the body; jerking movements of the back which carry the body forward, or simply twisting along in a sitting position without the use of either limbs.

The baby sat upright on the floor and hitched himself along without using his hands. Another baby sat on the floor and used only one side.

F., 9 mos. Little Nannie would sit straight up on the floor and without putting her hands to the floor, work along as fast as a person

would walk. She did not make much effort and her parents often wondered how she could do it.

F., 9 mos. Sadie hitched along using one (right) hand and foot.

F., 12 mos. Child was very backward in creeping and when she did begin she pushed herself along by her hips, first on one side, then on the other.

F., 14 mos. Violet never crept. When 14 months old, she moved around by sitting on the floor and using one leg to help her along over the floor. She put her leg and foot forward and then seemed to steady them and draw her body along.

F., 8 mos. Sat up straight and hitch along. She never crept, but after this stage learned to walk.

F., 9½ mos. Would sit down on the floor and push herself backward, moving a little from one side to the other. Could move faster in this manner than if she had crept.

M., 10 mos. This child would hitch along. It would have its left foot under its right. Its right knee was erect with its hands resting upon it.

Rolling. Rolling is an occasional form of child locomotion. 7% of the whole number observed rolled over and over until they arrived at the place desired. One peculiarity in this rather exceptional manner appears in the apparent deliberation of the child just before setting out as if to decide just what and how to do it, but after several attempts he becomes very proficient in its movements.

Occasionally we find a child which can creep quite well but rather slowly. But if it is in a hurry it will abandon this manner and lie down and roll over and over, thus going much faster. In studying the early creeping and rolling movements of her niece, Miss Shinn thinks that the child's skirts interfered considerably with the attempts to creep which the grandmother had attempted to teach the child but were abandoned in favor of rolling. She then concludes that "without the hampering influence of long skirts and the practice of keeping babies off the floor, this primitive quadrupedal movement would appear much earlier, and play a larger part in infant activities, than it does. If it preceded securely balanced sitting, the less natural and less useful hitching would never appear as a substitute." This conclusion is not warranted by the studies made upon the babies of primitive people who are not hampered by skirts or cold floors, yet they prefer hitching to creeping.

Exceptional Movements. Among the 3% of the exceptional movements are seen the following:— Crawling like a worm upon the belly with the hands and feet close but using them very little; swimming movements, the hands moving at the sides with feet kicking; moving backwards on the buttocks and elbows, the head occasionally striking the floor wearing a bald spot on the back of it; crawling upon the belly using hands and abdominal muscles to throw the body forward with considerable force; wriggling from side to side or forward and back-

ward on the buttocks without the use of the limbs; and attempting to move forward by swimming movements but thereby moving backward. In these returns the movements were recorded according to the sexes, but they distribute themselves about equally, so that it is not necessary to draw a further distinction.

Rolling.

M. This child first moved from place to place by rolling.

F., 9 mos. At the age of nine months Emily started to roll over and over across the floor. She would first raise her hands and feet to give herself a start, then roll anywhere she wished to go.

M., 8 mos. Walton made most progress when he rolled on his right side.

Hopping.

M. Harold went along like a frog. Laying palms of hands on the floor, then with a little jerk of his body would land on his knees. He would then begin again with his hands and repeat the same process. He progressed quite rapidly considering his method.

Swimming.

M., 9 mos. Carlyle creeps in a sort of half swimming manner. He lies on the floor in this position, his arms and legs are partly bent. He pulls himself along by using the arms alternately.

F., 8½ mos. Lies very flat on the floor with upper part of the body raised slightly. Both arms move outward at the same time. She then puts her hands flat on the floor and her legs move alternately. Then she brings the hands forward, the legs move, the hands move outward and so on. She does not get along very well and seems to try to move forward though moves backward instead. The child would simply wriggle and twist irregularly until he came to the object wanted.

M., 10 mos. Holt was sitting on the floor and near him was a chair, on which there was a bright apple. He looked at it a moment then wriggled over to the chair and taking hold of round by round he drew himself up.

Climbing. Climbing is one of the early impulses of children. Indeed, some of them manifest this desire as soon as they begin to creep. The desire to climb seems to arise in a desire to explore every available spot and practice every known movement. As arms and hands precede the legs in functional development, children may be seen pulling their bodies up alongside a chair, a table-leg or other object even before their legs are able to bear the weight of the body. An observer says of a little girl ten months old—"this child could climb upon chairs, upon the table and upon the refrigerator before she could walk. She had several falls, but nothing would stop this desire to climb until she learned to walk, then it seemed to pass away." There is a desire in the child to get up higher. This impulse leads it not only to draw the body into a standing position but also to get to the top of every attainable object. In the case cited, the desire to climb was inhibited by the ability to walk. This is not common in children, as the ability to walk simply opens

a wider range for their activity and thus favors it by an increased muscular vigor. Fear of high places or of falling is not at all common in the first acts of climbing. It is only after they have had several calamitous experiences that fear in some case may restrain this activity.

As the child grows in strength, the skill it acquires as a climber is quite remarkable at times, from chairs, tables and other furniture to fences, gates, ladders and trees. It tries an experiment continually to get into some new position and relation with an object with which it is engaged. One little fellow tried, after climbing to the highest part of a chair, to put himself through every open space in it. It was a pure love of climbing that engaged his attention for a half an hour.

M., 3 yrs. Everett is very fond of climbing up in and down out of wagons. He does it just for the sake of climbing. He always gets down backwards and never allows any one to help him.

F., 11 yrs. When I was small I climbed on the table set for tea and tipped it over. I was punished and much frightened, but it did not restrain my desire for climbing. When I went out into the yard, I climbed upon the top of a pig pen and fell in. The pig ate my hat and tore my dress, but I was rescued. The next day I was found on top of the same pen. I was afraid of the pig inside but I wanted to climb.

M., 2 yrs. At the age of 1½ years he was climbing all the time on chairs, high chairs, step ladders, etc. It was easier for him to get up than to get down.

F., 4 yrs. I had a great desire to climb up into the trees in the orchard. Mamma was often frightened to see me so high in a cherry tree. The higher I could get the better I liked it.

M., 14 mos. When John learned to walk he wanted to climb. One day he got on the table and broke his arm. After it had only been dressed one half hour, he got up on the chair near the window and broke the glass.

F., 10 mos. This child, before she could walk, would climb upon chairs and on the table. She climbed upon the refrigerator from a chair. She had several falls but nothing would stop her until she learned to walk, then her love for climbing seemed to pass away.

M., 18 mos. The door was open so that the child got out. When his mother found him he was climbing upon the horse trough.

M., 2 yrs. Wilbur would run away and climb upon every object he could find. Into the most dangerous places.

M., 14 mos. This child climbed into a chair, then upon the sewing machine, then on a desk a little higher.

Children first learn to get off of a bed or a chair and to go up and down stairs after they have learned to creep. It appears as a desire to follow a grown person, or a desire to explore together with the desire to climb. In getting off a bed the greater number of children creep or hitch along to the edge, then turn over on the belly, seize the bed clothes firmly with their hands and slide the body off the edge, holding with their hands, until the feet touch the floor, or drop heavily. Others, though few in numbers, slide off head foremost, by putting the

hands upon the floor and drawing the body after. One case was noted where a little girl rolled to the edge of the bed and then rolled off upon the floor, falling heavily; she repeated the process two or three times, but found it too painful, and after that remained upon the bed until some one took her down.

F. In getting off a bed she would lie on her stomach and keep backing down until her feet reached the floor.

F. She got off a bed by hitching over to the edge and then turning over on her face, she would grasp the clothes with both hands, slide both legs off, and then when nearly down let herself drop.

F., 2 years. If she was on a chair, or a bed, and wanted to get down, she would slide off on her stomach, if she could n't reach the floor, she would let loose and drop down the rest of the way, regardless of bumps.

M., 2 yrs. In getting off a bed he first puts his hands on the floor and slides the rest of his body after. He can walk well.

F., 9 mos. If baby wanted to get out of the bed, she would roll near the edge and then roll out upon the floor; she tried this several times and found that the bump was too great to endure.

In going up and down stairs, of the different ways employed the most common is creeping, in which the child goes up on its hands and knees or hands and feet; in coming down it will creep backwards, putting down its feet first on the next lower step. A child, in both ascending and descending a flight of stairs, will often turn to see how far up it has gone. Another manner of climbing stairs is that of creeping up and then turn and sit down on the step and slide down to the next one below, using the hands to steady the body. Some children go up stairs by drawing themselves up alongside of the banister with their hands and step up with their feet. This is a more mature method and is only employed by those children who have already learned to walk. An exception to the general manner is found in a little boy who went down stairs head foremost. He put his hands on the step and then let the body slide down after him.

F. In going up stairs she would place both hands on a step, then bring up both feet to the next lower step, and so proceed. In going down she would sit on a step and slide down to the next lower.

M., 14 mos. Soon after Harold learned to walk he began to go up and down stairs by holding on to the banister.

The child goes up stairs on its hands and feet and backs down in the same manner.

F., 2 yrs. In coming down stairs, Dorothy would sit down on a step, straighten out her body and slide down to the next one. In going up she would put one foot on the step above and taking hold of the railing would lift herself up until both feet were on the step.

15 mos. It placed the left foot on the lower step and brought down the right knee on the level with it; the child could hardly creep, but in this manner it learned to walk.

13 mos. This child often sits on a step and then slides down to the next lower, using the hands to keep from tipping forward.

M., 21 mos. Everett took hold of the banister and put one foot upon

the step, then drew the body and the other foot up. He rested awhile and repeated the act on the next step.

M., 2 yrs. Thomas always goes down stairs head first; he first puts his hands on the step and slides the body down behind him.

F., 18 mos. In going down stairs she laid flat on her stomach with her right leg and foot bent up acting like a rudder, the left leg extended straight from the body, and the hands rested on the step above as she descended. In this way she slid down the stairs as fast as one could run down. She crawled up on her hands and knees.

Rising into the Standing Position.

The child has learned to sit up by grasping a person's extended fingers and is thus pulled up. It will seize every available object within its reach. After it has learned to creep or hitch, and in some instances while still sitting in the lap, it will seize the extended fingers or other objects and brace its feet so that it may be raised into a standing position. [1]Mrs. W. S. Hall observed a child in the thirty-eighth week; he stretched his body and right hand toward his baby-carriage, within reach, and seized the handle firmly which he drew near enough to grasp with both hands. He then braced his feet against his mother's lap and pulled himself up, swaying back and forth, alternately pushing and pulling the carriage. He also pulled himself up by the extended fingers of the mother and remained standing a minute, when he was laid back upon the floor to rise again, this time standing two minutes. Several weeks later, at twelve months, he was able to rise by the aid of a chair, and remain standing for five minutes, holding to the chair with one hand while playing with the other. Some children delay standing if they are not given the initial suggestion, as was seen in Mrs. Hall's child, but are content to creep, until suddenly they will be seen rising up in the center of a room without support; first, from the creeping position to the hands and feet, they raise one hand carefully and place it upon the knee as a brace, and finally, with considerable unsteadiness, raise the body erect.

M., 12 mos. One day Melbourne was creeping on the floor when he saw something on a chair. He did not creep over to the chair, but stood upon his hands and feet, then raised one hand from the floor and soon raised himself up. He stood a moment as if to balance himself, then took two or three steps. He then took hold of the chair, got the object he wanted and sat down. After this he most always got up from the floor in this manner. This attempt was unconscious, for after he obtained the object he sat down and did not seem to realize that he had done anything unusual. It made his breath come faster.

F., 10 mos. Daisy, when learning to walk, simply rose from the floor, stood up and walked away. This was the first time she had walked at all.

F., 9 mos. Francisca never crept. One day she was sitting on the

[1]Child Study Monthly, Dec., 1896, p. 398.

floor and suddenly got up and started to walk. After walking awhile she fell; she laughed, got up again and started off.

M., 1 yr. Frederick was sitting on the floor. His mother came near him when he seized her dress tightly and pulled himself upon his feet. He stood for a moment and would have fallen had his mother not held him.

Standing. The child first stands resting its partial weight upon its legs when supported in its mother's or nurse's lap. The body is inclined forward, the knees and hips are bent. As the muscles of the back and legs develop the limbs are brought into line with the trunk, the spine assumes its double curvature, the child stands supported only by steadying itself near a chair or near the wall. The age at which children first are able to bear their entire weight unsupported upon their limbs varies from seven to sixteen months, the large number falling between ten and twelve months. Frequently, children who are not encouraged to rest their weight upon their feet do not show an early desire to do so. Mrs. W. S. Hall observed that the child braced himself in a standing position on the 135th day (4½ months). After that he was permitted to bear a part of his weight in standing when he desired. In this position children soon learn to alternate the use of their hands in supporting the body near a chair and may remain upon their feet for a half an hour at a time moving the hands and feet continually. When children arrive at this stage of development, there is a constant desire to remain upon the floor. One observer remarks that there was a great unwillingness to be taken up from the floor for meals, the child tried to take its food while standing.

The child learns to stand in the mother's lap and with her assistance, later, it learns to stand by means of a chair or wall. The first efforts were unconscious.

M., 8 mos. The first time Albert stood alone he was put near his carriage and had nothing to support him but the handles of the carriage. He was unconscious of it.

F. Edna would get a hold of the leg of a chair and pull herself up, sometimes making several attempts before succeeding. At times these efforts appeared entirely unconscious, at other times conscious. Her first steps were taken around a chair, then she went from one chair to another.

F., 16 mos. Nellie came and took hold of my dress and pulled herself up and stood for some time. I took her up, but she objected to this and let herself down and crept away. This was the first time it had been noticed that she stood. It seemed to be unconscious. Two weeks later she stood alone in the middle of the floor laughing and waving her hand. She received a severe bump which made her afraid to rise up unsupported until she had learned to walk.

M. Leon was creeping on the floor, and catching hold of the rounds of a chair he pulled himself up. He stood up because he wanted to, as there was no inducement offered. He was very proud of it. A fall which he received made him timid.

M., 1 yr. Marvin's first steps were beside a sofa. They were unconscious, for as soon as he realized what he was doing he fell.

F., 10 mos. The first effort Barbara made to stand was near her mother's knee. It seemed unconscious. Her breath seemed to be shorter.

F., 8½ mos. Alice's first attempt to stand was when she drew herself up by holding on to the table legs.

Movements Anticipating Walking.

For the first three months of the child's life the movements of the limbs are the so-called instinctive, reflex or organic. The limbs are bent most at the shoulder and hip joints. The large supra-spinatus and the infra-spinatus muscles of the shoulders are functioned at birth, making possible this movement of the arms, which is not in the same plane with a line parallel with the axis of the body, but varying about 20° toward the body from this plane, causing the hands to move mouthward rather than forward. The intentional flexion, as Mrs. W. S. Hall has observed, develops earlier than the corresponding extension. The child could put his thumb into his mouth, at will, but could not remove it. In the leg, the greatest amount of the early movement is caused by the flexion and extension of the psoas, iliacus and pectineus, which lie in front of the joint and the gluteus maximus and medius muscles which draw the leg into line with the trunk. At three months, the child of normal development is, without doubt, conscious of these limb movements which are gradually becoming more rhythmic and co-ordinated. They give him considerable pleasure, which exists in the consciousness of an ability to do, as observers think, rather than in the exercise itself. The arms and legs at times are moving quite in unison. Soon after this period, there appears the response to a stimulus applied to the soles of the feet, the tendency to push. When supported erect, the desire to jump, until the standing position is acquired, after which comes the alternating movement of the legs as above mentioned.

Walking. From the standing position it is a short step to walking. The first step is usually taken alongside of a chair or the wall. The legs have already learned the alternating movements by creeping and jumping in the lap or kicking. Very frequently the first steps are taken by lifting the feet and placing them again in the same tracks. Gradually the body moves and the legs are brought forward or backward to maintain the equilibrium. The chair may accidently move and the child follow it by taking a step. Then follow the movements from one object to another placed a short distance apart, or walking beside a person holding firmly to the hand or dress. One little girl at nine months of age at first clutched a person's dress in walking, then she seized the scallops of her embroidery on the bottom of her own dress and walked off bravely, feeling

perfectly safe. Frequently a child will not use a chair, wall or other object at all, it will rise up in the centre of a room and steady itself, then take several steps unsupported.

Some children walk by pushing a chair about a room, thus continually steadying the body; others are assisted by their parents, who support the weight of the body, allowing the feet to touch the floor and the legs to move. When left to themselves after this exercise, they will attempt the movement alone, and at times will succeed quite as well. At first children are afraid to let go their hold of a support, unless some especially attractive object or considerable encouragement from the attendants makes them forget the bodily state and they totter along unconsciously. After confidence is acquired, they reluctantly return to creeping, and prefer walking even to riding.

Children, as a rule, walk "pigeon toed," and it is only by a process of growth that the feet assume a proper angle and the legs become straight from the "bowed" condition at birth.

M., 11 mos. Albert was playing with the front part of the carriage when suddenly he began to walk, being unconscious of what he was doing.

F. She could stand alone near a chair or wall. The first steps were taken while leaning against the wall. Her mamma stood a few steps off with her outstretched arms coaxing the child to come to her. She ran into her mother's arms and repeatedly did so until she could walk alone.

F. Her first steps alone were in going from a chair to a person's arms a yard distant. She tried it very timidly at first and fell several times in the attempt. At last she succeeded and was so perfectly delighted to think that she could walk without help.

M., 11 mos. Harold walked toward a little dog which he had not seen before. I do not believe he was conscious of what he was doing for he was so intent on the dog. After this he walked so much that he could not rest at night.

M. Leon's first steps were taken between two chairs. After he had learned to walk, he would tire himself out so as to be sick.

M., 10 mos. Jack was creeping one day, when he came to his chair he stopped suddenly and looked up. By the aid of his arms he pulled himself up slowly and carefully on his feet (all during the process his tongue was out), at last one hand reached the seat of the chair and Jack was on his feet. He began to spring and laugh then turned to his mother, who was opposite, and made three steps to her knee, balancing himself by holding out both arms. He was so well pleased that for several days he would always go to the same chair and begin his walk.

F., 9 mos. Alice's first steps were taken when she was 9 months old. She walked by pushing a chair around the room. At times she would leave the chair and take a few steps toward her mother who stood near.

M., 10 mos. Frank could stand by holding fast to chairs, table legs, etc., but he had not walked. One day while he stood near a chair, his mother invited him to come to her. He started and walked all the way across the room to her. He was very proud of this feat, although he did not walk alone again for two weeks, during which time he clung to the chairs and the walls.

F., 11 mos. The first unsupported steps were taken between two persons sitting about four feet apart, they were quite conscious, being the

result of considerable coaxing. The steps were carefully taken, the body settling firmly at each step, the arms were extended. There was a decided leaning forward of the body with the right side a little forward of the left. She has only walked when asked to do so.

Consciousness of Standing and Walking.

Several questions will arise at this point which it will be well to consider. First—are these first efforts to change the verticality of the body in standing and walking, conscious efforts on the part of children? Second—what are the effects of standing and walking upon the physical organism? Third—how do they effect the psychic life?

Let us consider the questions in the order in which they arise. First—are the first efforts to stand and walk conscious? The writer realizes the difficulties into which this question at once plunges one, since it involves the whole question of the relation of consciousness to life.

The returns in answer to this question are not at all unanimous, since they confirm both the consciousness as well as the unconsciousness of the movement. A careful study of them, however, does not reveal such a diversity, as it shows that the observations were made at different stages of the child's development and upon different children. Let us consider several concrete cases. A boy nineteen months old, who had never stood alone, while sitting upon the floor saw a fly on the wall. He took hold of the table leg near him and rose on his knees, he then stood that way for a time, then by degrees he rose to his feet. When he was up he looked for the fly which had gone. He sat down with a thump and did not try to stand again for five months. A little girl, one year old, saw some candy in a chair, she crept to the chair, then climbed up and stood unsupported. As soon as she seemed to think of what she was doing she sat down. Her breath then came fast. Another child saw his mother handling his red dressed doll; he crept to her, pulled himself up and stood. The observer believes that he was entirely unconscious of all else but the red dress of his doll.

Another example is given by Professor Kirkpatrick of Supt. Hall's little girl. She was, in all respects, a normal child, but unable to walk at seventeen month of age. One day the father came home to dinner and placed his cuffs upon a table and laid down to rest. The child, seeing the cuffs, crept to the table, pulled herself up by the leg of the table, took the cuffs, one at a time, and slipped them over her wrists, standing unsupported while doing it. She then stood looking very much interested in the cuffs. Then, to the great surprise of the father, she walked with great confidence with a pleased expression on her face. She also ran, continuing this for ten minutes, then sat

down and rested, after which she arose alone and walked again. Without the cuffs, however, she could not be induced to take a single step. She was given an old pair of cuffs and she seemed greatly delighted; she walked and ran as before. She used the cuffs for two days, after which she walked without them and did not revert to crawling.

There are many other observations which might be cited to show that the evidence is against the popular thought that the child must learn to make these movements. That he must, from the infinite number of possible movements, select, from the four hundred muscles which move, the right muscles and the correct combinations of these to enable him to move. This task would be too enormous for the space of a year or fifteen months.

Another view is that walking is entirely instinctive and that it is inherited as in the young animal; but, as Prof. Bain says, the mechanism at birth is not completed. There are children who walk the very first time they make the attempt, so that this view has much in favor of it. But the walking in a large number of children will not support this theory by the evidence it gives.

We are then given a third view, that often held by psychologists and physiologists. This theory sets forth the play between the unconscious and the conscious elements.

Common observation shows that the reflex movements of early life are a natural concomitant of the organism and become established in consciousness, and consciousness in turn assumes a directive control over these organic movements and builds up complex groups, which in turn make possible more complicated movements. Very early in the infant's life it can be seen attempting to imitate a movement which it has seen, or when it is intensely interested in the movement of a person its body will respond very markedly. This does not seem to be a matter of chance, but there is undoubtedly physiologically a close connection between the visual and the motor centers. This physiological part determines the direction of the impulse.

A child sees an object, he grasps it. The visual sensations call into play the movements of the proper muscles. The conscious element is the visual image, the motor element is unconscious.

I am practicing to throw a ball at a target. The attention is focused upon a spot in the center of the target, that alone is in consciousness, the movements of the arms, the position of the body and legs all adjust themselves unconsciously to meet the impulse from the sensory center. The same is seen in the case of a child's walking. He has a visual impression, a fly, a red dress or what not, this is sufficient to call into action the motor apparatus at the time when it is developed sufficiently.

The close relationship existing between the sensory and the motor centers makes possible even new co-ordinations with the attention directed toward the former and surrendering wholly to the unconscious the motor element.

Let us suppose the child sitting upon the floor; he is able to creep but does not take any steps. He sees a fly upon the wall. A visual impulse comes to him, it is strong enough to absorb his attention, and movement results. The functional development has advanced sufficiently that the co-ordination may be made. The child rises up and stands. Or another child's attention is entirely concentrated upon the getting of the cuffs, putting them on, etc. The attention is not, in either of these cases, upon the movements, for when the visual image is removed, the motor image arises, the newness of the situation at once destroys the co-ordination, and the child sits down. The direction of the attention toward the movement disturbs co-ordinations of movements rather than favors them in children as well as in adults. But there is another element which enters in. Many children, before they are strong enough to walk are held upon the floor or table with their feet touching which no doubt suggests walking, they are urged and guided and led. Here the conscious states no doubt precede the functional, since we can see such children trying to repeat the position and movements which have been suggested to them in this manner by their parents or nurses. This is, however, reversing the biological order of development.

F., 13 mos. Gladys pulled herself up by her mother's dress, after she became conscious of her power she felt very proud of it. Her breath was short from the effort of it.

M. Tommie's mother had a doll dressed in a bright red dress in her hand. Tommie was sitting on the floor near his mother when he became so interested in this doll that he pulled himself up by her dress and tried to reach it. I think he was entirely unconscious of what he was doing, except that he saw the doll. After he had got on his feet he stood for a few seconds.

F., 24 mos. Alice first tried to stand by pulling herself up by chairs, etc. I think the first efforts were unconscious for she usually made them while trying to reach something. After she had made her first successful attempt she looked around to see if anybody had noticed her.

F., 1 yr. Margaret was sitting on the floor beside a chair, she tried to stand by taking hold of the chair, but failed. She made several attempts before she succeeded. Finally after she had stood for a few moments she looked around to see if any one was seeing her and smiled. I think she was conscious of the act.

M., 11 mos. John was placed in a wash-tub with cushions in the bottom. He reached up and placed his hands on the side of the tub and then tried to stand on his feet. At first he was on his knees then stood on one foot. He would fall, but not be discouraged. He worked fully five minutes trying to get on his feet, his face was moving and his breath came quickly. After he succeeded in standing up he began to laugh.

Physical Effects of Standing and Walking.

Second—What are the effects of standing and walking upon the body? In the first place, after children have learned to walk and have gained confidence, they become passionately fond of it and, Gross has observed the same fact with reference to their play, there is a tendency to walk until exhausted, which produces a general physical change. This fact seems sufficient to break down the surplus energy and pleasure and pain theories of walking as well as playing. The metabolic processes are increased, the circulation of the blood becomes more rapid, the respiration increases, the appetite often increases to a marked degree. Children who have been pale and sickly before, often become ruddy and strong, possessed with new life and over-flowing with energy. At the time the first step is taken, the face becomes flushed, the breath short and panting and the whole body often trembles with excitement and eagerness. The fatigue which sets in, is at times so great that sleep is impossible, and when induced the body twitches and tosses from side to side.

Effects on Different Parts of the Organism. The change produced on the muscular system by walking is most marked. The great muscles of the calf of the leg, the tricept extensor suræ, are much increased in size, the psoas ilíacus and pectinéus of the upper part of the leg become hard and resisting. At first, there may be a marked decrease in the size and fullness of the leg which is due to the rapid loss of fat before the muscles have had time to develop. The great glutaei muscles of the buttock and the erector muscles of the spine grow in size and complexity, the latter fill up the vertebral grooves and send up tendons along the back like stays supporting the masts of a ship. These are the characteristic muscles of man and they are comparatively undeveloped previous to this time.

But muscles are easily fatigued and in order to compensate this, the joints and ligaments are fully developed. The body is so held that the center of gravity falls directly upon the ankle-joint, this produces the greatest stability and reduces the muscular force to a minimum. At the knee the center of gravity falls a little in front of the axis of the limb, the back and sides of the joints are provided with check ligaments to hold the joint locked in a position of hyper-extension, so that no muscular force is required to maintain it. In the first efforts of the child to stand, the knee is bent forward hanging the entire weight of the body in the contraction of the muscles, but as he extends the legs the joints become locked and static.

M., 5 yrs. Theodore never liked to be dirty nor romp out of doors, he eats very little, is pale, good tempered and always quiet.

F., 2 yrs. Edith is always running about and would much rather climb and run than play with her dolls. Her circulation is good, her

cheeks have color, she is always full of life. I think it is the romping out-door life that makes her physical condition so different from her brother's.

F. When she had walked until tired, she would continually fall down.

F., 12 mos. Marie seemed to grow more after she commenced to walk.

M. When Walton first stood he got very nervous. In a short time he would fall down. There was a tendency to use his hands more. He became stronger, healthier and more active as he walked more. He required more food. He often ran away.

M. After he found that he could walk he was doing it all the time, when asleep he would moan and twitch from sheer exhaustion.

F., 2 yrs. Alma was very sick until she was two years old. Then she began to walk and she gained in health. She was entirely well at four years of age.

At this time there is a marked increase in the size and fullness of the legs.

F., 2 yrs. The child had walked for some time, one morning she could not use her legs at all. She had n't been sick nor had she fallen. The doctor could not account for it. By constant rubbing for two days she was able to walk again.

M. As soon as the child began to walk, his appetite was better but he became thinner.

The child got so fatigued that it could not rest at night. Children as a rule walk too much.

M., 18 mos. There was a marked increase in the child's appetite. The general disposition is better, it cried less after it had learned to walk.

F., 16 mos. Her breath was short and quick. There was a marked increase in the size of her legs.

F., 2 yrs. She slept better and had a better appetite and was immensely more mischievous.

Rhythmic Movements of the Arms.

Arms. An increased activity is seen in the movements of the arms and hands. There is a rhythmic movement in the arms which alternates with the movements of the legs. The child also has a passion for carrying objects. One child could walk more securely when it carried in its hand the folds of its dress. Several observers noticed that the child acquired greater skill in the use of its hands in examining various objects, while walking. This is due to the general development of the muscular system and it also absorbs the attention of the child, giving the lower center fair play.

M., 10 mos. At this time the arms are used also as much as the legs.

M., 14 mos. After walking he made greater use of his hands. Because more active in examining objects round about him.

Children like to use their hands carrying things while walking.

F., 20 mos. The child learns to use its hands more successfully when it learns to walk.

Mental Effects.

F., 16 mos. When she succeeded in standing she laughed and crowed.

F., 2 yrs. After Magdeline learned to walk she seemed to be a great deal happier.

F., 10 mos. Helen was happy whenever she made a step, she would look around and laugh, then would jump up and down by bending her knees, without raising her feet from the floor.

M., 11 mos. Since Fred learned to walk there has been a marked change in his temper. He was very cross and cried easily, now he rarely cries.

M., 1 yr. The child seemed happier and sweeter tempered after he learned to walk.

Third—How does standing and walking affect the child mentally? With the ability to creep there comes a desire in the child to push out and enlarge its sphere of activity. This desire is increased with the ability to walk. There is a keen desire to explore every unknown region and to examine every unfamiliar object. The emotional life receives a new stimulus. The child becomes elated over its own accomplishments. How the little one laughs for joy when it can rise up near a chair and is conscious that some one is seeing it. One observer writes that the "little girl slapped the seat of the chair near which she was standing with her hands, then turned to her mother with an expression of great pleasure upon her face."

The child grows happier in spirit, it can busy itself in its walks by examining new objects, thus receiving new external stimuli. One mother says—"After Fred learned to walk there has been a marked change in his temper. He was very cross and irritable, he cried very easily, now he rarely cries."

Should Parents Assist Children in Learning to Walk?

The question was asked whether parents should assist children in learning to walk. There were seventy-five answers given, all of which indicate very clearly the one fact. That is, that the assistance of parents should be to prevent falling, which incurs physical injury, discouragement or fear. But they should not lend this assistance until the child first makes the advances, nor should they encourage the child at any stage except as it may lack courage, or if there is danger of post maturity. This is fundamentally in accord with the line of development. At the functional stage the desire appears in the normal child; but it may be inhibited by the effect of another stimulus as was seen in the child who stopped climbing after he had learned to creep. The physiological effect of walking is important here. After an organism has functioned, the growth is much more rapid, we see this in the case of a boy who was very small and pale and inactive until he learned to creep and walk, then the whole organism apparently received new life, the metabolic processes increased and the child grew strong.

Post maturity may thus be avoided by the suggestions and assistance of parents without endangering the normal development of the lower limbs.

These returns leave no place for the walking chair nor any other mechanical devices of body braces, etc., for the child's assistance, and they agree with Dr. Ploss that the child will learn by its own efforts. But there is a deep pedagogical principle underlying the co-ordinations of these early attempts. If the average normal individual can be assisted at the proper times so as to avoid the dangers of mental discouragement, the realization of his growing power will soon be evident. Few children have sufficient combativeness to prevent, at this time, a breaking down of the co-ordinations which have formed in the nerve centers during the earlier successful attempts by injurious falls. The problem of the psychology of success is awaiting a scientific investigation, but it is a matter of common experience that every successful step is so much gain in favor of the next succeeding. Let the individual feel that he *can* do, and having once experienced the doing he is essentially stronger physically as well as mentally for the next similar action. Observations made upon children show that they are indeed very responsive to such conditions.

Reversion.

According to the famous riddle of the sphinx, man shall again surrender his upright posture and turn his face toward the earth from whence he came.

We have thus far traced his rise, let us now observe some of the causes of his reversion. For a considerable time after children have learned to walk and run, they frequently revert to their early stage of creeping, due to some physical or psychic disturbance. The effect upon the organism, of whatever cause, may be temporary or permanent.

The temporary reversions may be due to—fits of anger and crying or laughter mingled with fatigue; to fear resulting from a fall; to various children's diseases which divest the organism of strength during the early walking stage, so that the child, upon recovery, must learn to walk "over again." When the child is asleep the body curls up, approaching its earlier stages, or when in a hurry the early creeping movements will be resumed. While insanity, deformities, nervous and muscular diseases more frequently cause permanent reversions and old age completes the cycle.

Let us now consider more in detail these tendencies so common, yet so unfamiliar, in the development of the human being.

A fall during the early walking stage, which does not produce physical injury or cause fear, is of little consequence to the

average child. It simply has the effect of a slight annoyance which only invites greater persistence. But if the fall produces a physical injury or is of a serious nature to frighten the child, it becomes exceeding discouraged, which will frequently destroy all confidence even to make an attempt for days, weeks, and in extreme cases even years. One observer speaks of a child who, while attempting to walk, fell upon a lifter which was lying upon the floor and cut his head. He became so discouraged that he did not attempt to walk again for almost two months. Another mentions a little girl two years old who had walked for about two weeks when she received a severe fall. It made her so timid that she would not attempt to stand up after that for a month. When urged to walk by her mother she would say—"I's 'fraid."

Miss Shinn has observed an interesting point in her niece. While the child was on a railroad trip, with its parents, of five days' duration, during the early walking stage, and was carried much in the arms, she became less disposed to stand and creep. For when she returned, she crept shorter distances, she only reached toward some desired place or object; and when the distance was about 12 or 15 feet she would creep it unobserved, but if noticed, she wished to be carried.

Effect of Falling.

F., 10 mos. She seemed to enjoy falling as she never hurt herself by it. She always tried again after a fall.

F., 2 yrs. When Sarah was two years old she fell down stairs while trying to walk down. From that time until she was four years old, she would never try again, but must be carried down.

F., 1 yr. Helen, while learning to walk had a severe fall, and was hurt quite badly. For about a week she would not even try to stand and seemed very timid when she finally did try.

M., 6 yrs. This child could walk very well when two years old. He received a bad fall which injured his spine, after that, it was a year before he walked again. He is now six years old, and yet, when he walks, he drags his feet.

M. When attempting to walk he fell upon a lifter which was lying upon the floor and cut his head. He was so discouraged that he did not attempt to walk for almost two months.

F., 2 yrs. Ruth had walked for about two weeks when she received a severe fall, which made her so timid that she would not attempt to stand up after that for a month. When asked to walk she said—"I's afraid."

F., 16 mos. When she fell, she was not at all dismayed or discouraged.

F., 10 mos. When Marie fell she would not try to walk again for some time, it frightened her.

M. The falls which this child had were not of a serious nature and after each he would get up and try again.

Effect of Fright.

M. A little boy who had not been seen to stand alone before was noticed one day to stand in the middle of the floor. Several persons

who saw him cried aloud in surprise. The child sat down and could not be made to stand again for some months, the cries having frightened him.

F., 10 mos. One day Helen laughed and jumped so much that she got out of breath and fell over, she showed by the expression on her face that she thought that I had thrown her over and was afraid of me for some time, yet she tried again.

M., 21 mos. When warm weather came, Rnssell ran out of doors and climbed up the grape arbor. When he got up a certain height where he could go no farther, he began to be frightened. He was aided in getting down by the observer and after that avoided the arbor.

F. Elizabeth gained better control of her hands when she walked, she would go to her mother's work basket and carry away the thimble and thread. One day she pricked her finger with a needle and after that she was afraid to go near the basket.

HURRY.

F., 20 mos. When twenty months old she would run away, but whenever she wanted to get anywhere in a hurry she would always get down on the floor and creep faster than she could walk.

This child had the habit of creeping on its elbows and knees, but when it wanted to go faster it would roll over and over.

F., 12 mos. When Retta had learned to stand and take several steps alongside a chair and saw an object that she wanted to get quickly she would roll over and over toward it, this being her earlier manner of locomotion. This was also the method employed by her mother in childhood.

M., 9 mos. His natural manner of movement was on his stomach pushing himself forward with his hands and knees. When in a hurry, he spread his hands and feet so that he seemed to crawl like a crab.

M., 8½ mos. G. creeps in several ways. If he sees something which he wants, he first gets on his hands and knees and starts forward. This way does not seem fast enough, so he turns and pushes himself backward (still on his hands and knees). Finally, as if all impatient, he lies down flat upon his back and rolls over and over until he reaches the object. He always tries these three methods if he is in a hurry, but ordinarily he simply creeps, usually backwards.

Laughing. The physical act of laughing, as described in [1]Drs. Hall and Allen's study on the "Psychology of Tickling, Laughing, and the Comic," appears to be one of the very common causes of reversion. At first laughing causes a "feeling of bubbling over," "a ticklish sensation in the stomach," a feeling to "laugh or burst," as a "store of energy which must be expended to relieve a strain," and various other feelings akin to these. Then the lips curl, the body becomes unsteady and sways back and forth, the head is at first thrown back and the mouth opened wide, then the muscles of the neck jerk, the head falls forward, the shoulders shake, and the body doubles up convulsively. Sometimes the subject may fall upon the floor and end with sobs and crying or is seated doubled up with his elbows akimbo or planted upon the knees holding his sides; the body rocking violently back and forth. The limbs jerk, the

[1] *Am. Jour. of Psy.*, Vol VIII, No. 2.

feet stamp and the fists pound. The breast heaves and the diaphragm moves at times almost convulsively. Little children jump up and down, lie on the floor and roll all over the room. The fit of laughter is followed by a state of fatigue and soberness with intermittent sighs, heavy breathing, weakness localized in various parts of the body, stitch in the side and soreness, sweating, chills, uncontrollable movements, etc. A study of the physiological effects of violent laughter, as has been shown by Dr. Hall in the majority of adults, are first seen to begin with the highest level in consciousness, of the Hughlings-Jackson theory, "with the finer muscles, and passes downward to lower levels and more fundamental and early developed musculature, although in some children this order is exactly reversed. Expectation, perhaps all that is available, is strongly generated in the higher regions of consciousness; the resulting movements pass down the genetic and perhaps meristic levels till circulation, glandular, and even intestinal and excretory activities are affected and the sphinters relaxed. Let us now consider a little further the physiological effects of laughing and crying as well, since their effects are the same physiologically whatever other differences there may be. [1]The weight of the viscera in quadrupeds is hung from the horizontal spine by means of a strong elastic suspensory bandage of fascia, the tunica abdominalis. In man, who has assumed the erect position, the weight of the visceral organs is thrown upon the long girdle, hence the pelvis has adapted itself by becoming more dish-like. The tunica abdominalis, in man, near the thorax has entirely disappeared; in the groin, where it is of use, it still remains to strengthen the weak parts. It is quite common in children that a fit of crying or violent laughter may cause such intense downward pressure that the muscular ligament of the abdomen is insufficient to withstand it and the ligament breaks, which is testified by the prevalence of hernia. A mild form of the strain upon these comparatively unsupported parts is evident in the feeling of weakness, the stitch in the side and soreness in the groins. As the body is thrown forward in violent laughter, and doubled up, these parts are considerably strengthened by a counter pressure of the legs and ribs as they approach each other.

Sleep. All the various positions assumed during sleep are reversionary, except the one in which the subject lies upon his back. [2]Dr. Osborne has investigated the most favorable position at the various ages of life. He found that children under fourteen years sleep equally on the right side, the left side and on the

[1]D. F. Baker: Am. Assoc. for Adv. Viscera, 1890.
[2]Osborne: Dublin Quarterly Journal of Med. Science, 1859, Vol. XXVIII.

back; but that young girls and youths from fourteen to twenty years of age sleep most often on the right side. Fifty-nine cases slept on right side, twenty-nine on the back and twenty-three on the left side. In the side positions the arms and legs are curled up near the body and the spinal column more or less curved forward. Soldiers have also been observed to sleep more often on the right side than on the left. [1] Marie de Manacéine has for the last five or six years made observations concerning the favorable effects of changing the positions of the body as often as possible during sleep and believes it to be hygienic for a person to lie upon the stomach at least half an hour every morning before rising. She has observed that this position, if taken every day, exercises a salutary influence on angina pectoris, and other diseases of the chest and throat. Marie de Manacéine has also observed that little children have a marked tendency to sleep in this position, flat on the belly, but they are broken of it, she says, by parents and nurses, evidently from the fear that they may acquire bad habits.

It is evident that man is forced to pay a toll to the god of nature for this privilege, which he has over other creatures, that of turning his face heavenward, by having visited upon him various disorders and diseases from which animals are entirely free.

The influence of the upright position is seen on the circulation. In the horizontal position, the great vein trunks favors an easy flow of blood to the heart without too great acceleration. Dr. Baker[2] has observed two mechanical defects which man, in the vertical position suffers; first, the difficulty of raising the blood through the ascending vena cava, causing congestion of the liver, cardiac dropsy, and other similar disorders, and second, the too rapid delivery through the descending cava, causing syncope or fainting if for any cause the action of the heart is lessened.

Clevenger discovered that the valves of the veins are arranged to favor the horizontal position. In the large vertical trunks, where they would be most effective to resist the action of gravity, Clevenger found in the most important trunks the valves wanting, which causes disorder due to hydrostatic pressure, varicose veins, varicoceli, hemorrhoids, etc. He found them present in some of the horizontal trunks, where, so far as can be determined, they serve no purpose. Place man in bed and the valves are arranged with reference to the action of gravity in the horizontal position.

When the sick man retires or the weary man lies down it is

[1] Marie de Manacéine: Sleep, its Psychology, Pathology, Hygiene and Psychology.

[2] Dr. F. Baker: Am. Assoc. for Adv. of Sc., 1890.

not merely a conventional matter but one of deep physiological significance. Since it adjusts the position of the body to the most favorable condition for the action of the vital organs, as well as a general relaxation of the organs.

There is, also, a word to be said in favor of the position upon the stomach and face from a physiological point of view. It may appear an uncomfortable position, yet children prefer it to any other.

The back position will cause the viscera to rest their weight upon the descending circulatory trunks, at times a stomach full of food is added to the weight and the trunk circulation may be below normal while there may be an abnormal flow of blood to the brain through the ascending aorta. The position in sleep, then, is not a matter of entire indifference, but may have considerable influence upon the general health.

Diseases. The effects of the common children's diseases are of a little more serious nature than those of falling. The organism is depleted of its strength while valuable time is lost at a critical stage in practice. The returns show conclusively that a child may have sufficient strength to carry the body but he has simply forgotten the movements. A pitiful case was reported by a mother whose child had been ill for two weeks with the measles immediately after he had learned to walk. The disease had not been serious, but it had kept him in bed. After recovering, when he tried to walk again, he did not know how to do it. He manifested great surprise and chagrin at his failure, for he remembered that he had walked before. After his mother showed him how to place his feet, he eagerly and successfully followed her instruction. This lighter form of disease depletes the physical strength but temporarily, and upon recovery it is soon restored without entirely destroying the mental image or the nervous co-ordinations. There is, however, another form of disease which strikes at the fundamental root of motor-life, hence it invariably proves fatal to the muscles involved. These are the diseases characterized by the progressive weakness and atrophy of certain groups of muscles, or cerebral lesion which seldom causes paralysis of the lower without similarly affecting the upper extremities.

The term "progressive muscular atrophy" was formerly applied to a single type of disease which was considered a designation for an entire group of diseases. Later study, however, established two distinct diseases instead of one—the first was the "progressive muscular atrophy," as described by Aran and Duchenne; the second pseudo-hypertrophic muscular paralysis. Various different forms of these have been described by recent students. The various types of progressive muscular disease

have been established in accordance with their topographical distribution of atrophy and hypertrophy.

The so-called "progressive muscular atrophy" is a spinal-cord affection which, as a rule, begins late in life. It begins, in general, with an atrophy and a corresponding weakness in the small muscles of the hand, whence it extends from muscle to muscle to the deep muscles of the thenar, to the flexors and extensors of the forearm. Then to the flexors of the upper arm, and finally to the muscles of the trunk, shoulders and back. Duchenne recognized the fact that atrophy may, in exceptional cases, begin in the trunk, shoulders and legs. Sachs[1] observed several cases in which atrophy in the lower extremities began almost simultaneously with that in the upper extremities. As this disease progresses the wasting of the muscles becomes more and more extreme. The patient loses power of locomotion and becomes bed-ridden from which death releases him after many years of annoyance.

Hoffmann cites the case of a girl four years of age: At birth the child was entirely normal, she was able to stand at nine months of age. There was an early abnormal development of adipose tissue. Gradually the child became so weak that she could not stand, could not sit upright in bed, could not turn around without assistance. For a long time she was unable to move her feet and arms. She lost her superfluous amount of fat as the motor disturbances increased gradually and became emaciated especially in the extremities and the trunk.

The face remained full, mentality good, speech normal, mastication unimpaired, the child could turn the head but could not raise it from the pillow. The paralysis was in proportion to the atrophy of the muscles. The nerve-trunks were neither thickened nor sensitive on pressure. The paresis and atrophy of both upper extremities were entirely symmetrical, and the sensation was normal.

The muscles of the back and abdomen were paretic, the long erectors of the back diminished in volume and power. The gluteal and muscles of the thigh were almost completely paralyzed and very atrophic. The muscles of the leg were atrophic and paretic. The movements of the toes were almost normal. The paralysis was symmetrical and flaccid leaving no sensory disturbance.

Muscular Pseudo-Hypertrophy is characterized by its occurrence in early youth. It has been considered as the most pronounced form of primary myopathics, and not of spinal origin. But as new types of muscular diseases were described the cases reported inclined rather to the spinal than to the pseudo-hyper-

[1] Sachs: Nervous Diseases of Children, Chap. XXIII.

trophic form. Recently sufficient evidence has been brought to show that all the primary myopathies are closely related to one another, and that the early described types are but peculiarities in the topographical distribution of diseases which should be included under the broad term of progressive dystrophies. There are various types of the disease which are distributed among the affected parts differently which we cannot mention here. One example will suffice to show the effect upon the muscles of locomotion. The disease is more common in boys than in girls, but inherited through the mother. Its first symptoms are, a weakness in the muscles of the legs, an increase in the size of the calf muscles. The gait becomes wabbling, and the child soon finds difficulty in walking up and down stairs, in climbing upon chairs and off, in raising the body in an erect position, the patient usually "climbs up upon himself." In later stages the patient, if placed upon the floor, lies absolutely prostrate and is unable even to raise the head. Sitting becomes impossible. The patient may lose all power of the lower and upper extremities except the small muscles of the hands consequently the hand may climb up in order to carry up the arm.

Effect of Disease.

M. Herbert had the whooping cough and became so weak that he could not walk. When he got better he had to learn to walk over again.

F-, 9 mos. When Alice was learning how to walk she was taken with the measles. After recovering she was very weak and did not attempt to walk for some time. When she did begin, it was like beginning over again. She first began to stand then, finally walk.

This child was taken ill wilh scarlet fever and did not attempt to walk for six months.

F., 9 mos. When Florence was nine months old she could walk all around the room by pushing a chair. She was taken sick with bowel disorder, after which she did not walk until she was fourteen months old, when she had to learn all over again.

M., 3 yrs. Was taken sick when three years of age, and could not walk after that until six years old.

M., 2½ yrs. My brother walked when nine months old. When he was two and one-half years old he was very ill with spotted fever. After the illness he could not walk but learned again to creep and then walk.

M., 20 mos. When Willie was a year old he could walk quite well. He was taken sick with bowel trouble which left a fever and chills with him all summer. When he got rid of these he could not walk, but had to learn over again.

Idiots and Imbeciles.

In general idiots or imbecile children are awkward in their general movements and considerably retarded in their voluntary co-ordinations.

Dr. Ireland[1] investigated the development of 111 cases of idiots who learned to walk. The average time at which they learned was at the age of 2½ years. Five of these are stated to have begun to walk at one year. This lateness in learning to walk, according to Dr. Ireland's report, may be due, in some cases, to weakness, in others to nervous disease, but there are cases where the child appeared strong and healthy, and the deficiency was in the power of mental guidance. The gait was awkward and was acquired along the line of least expenditure of effort, and it was never changed or improved. If the children were required to walk upon a plank, they were successful according to the degree of intelligent. The most intelligent succeeded best. They balanced the body poorly, the hands were flapped or vibrated about instead of being employed to seize and hold with intelligence.

A comparative study of idiots and imbeciles and normal children produces a valuable suggestion which shows in a measure conclusively the part played by intelligence in learning to walk. The average age at which normal children begin to walk is 12 months. (Dr. J. Crozier Griffith—Care of the Baby.) The imbeciles, according to Dr. Ireland, begin at about 2½ years. There is a difference of 1½ years that the normal child has the advantage. The physically abnormal idiots are ruled out, so that under normal conditions the organisms would function at about the same time in the two cases. But we see a difference of 1½ years. This difference may be due to two causes. First—the psychic activity of the idiot is more sluggish than that of the normal child. He may receive the same stimulations but these do not establish the same associations in consciousness, hence he lacks the prevision of the normal child. This produces the second or physiological cause. The functioning of the organs is delayed because of a failure to take advantage of wholesome exercising and experience. The former to stimulate the organism, the latter to form the basis of new and higher activity. When both the imbecile and the normal child arrive at the age of twelve months, the latter has been responsive and has been stimulated to activity, his bodily organs are stronger; he has profited, the latter has not. One child devises methods to give expression to the natural desire within him, and often changes these; the other accepts the more simple means which require the least mental effort and they are adhered to without change.

[1] Mental Affection of Children.

CONCLUSIONS.

[1] "Nature has succeeded in making a man; she can go no farther. Organic evolution has done its work." In the foregoing chapters we have seen how the human organism has assumed the upright position, expressing the fullest range of possibility and the limit of organic evolution. In concluding, let us further consider the effects of this attitude upon the mental life. [2] Masso has said that the mobility of an animal is an index to the intelligence of it. "Among all birds the parrot is the most intelligent, because it makes more use than do all the other birds of its legs, beak and tongue. The elephant is more intelligent than all other wild animals, because he makes use not only of his legs, but also of his snout as organs of movement."

If the state of intelligence depends upon mobility in animals in general, whose limbs are used entirely for locomotion, what an enormous advantage is given to man over other creatures. His bodily size and weight is midway between the small and feeble creatures and the large and clumsy, thus combining grace with strength; and his body is balanced upon one pair of limbs, setting the others free. The movement of the arms is as varied as a free-moving radius of a sphere; add to this the infinite number of movements of the digits and there is a complexity of enormous significance which sends its impulses to the central nervous system. Indeed some of the modern writers consider that human intelligence, as such, has arisen in direct consequence of man's assuming the upright position, [3] so close is the relation existing between the mental life and muscular movements. Many persons consciously experience this in not being able to think if they suppress the muscular movement.

If we accept with Höffding the conclusion that mental and physical activity are not different things, but opposite sides of the same thing, we can accept the axiom that the mind can only be educated through the senses, and the more senses and the better they are developed the greater will be the possibility of the mental power.

Not only are the arms and hands by the erect position to present new and varied stimuli but the eye is raised enlarging the field of vision in the farthest horizon, enabling it to act like a sentinel for the other senses against friend and foe. The eye is placed in the skull so that there may be the greatest possible centration of attention. Perhaps it is that advantage which the senses gain in their wider range that gives man a passion

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[1] Drummond—Ascent of Man, p. 99.
[2] Decennial Volume Clark Univ. Address.
[3] Districker: Bewegungs vorstellungen.

for climbing high hills and mountains, that he may look about over the wide expanse. What a feeling of exultation does he experience as he views the plains, cities and living creatures lying at his feet.

The proud and haughty spirit is not common in short and stooping persons, but it manifests itself in the strut of the pompous person which plainly over emphasizes the upright position.

The attitude of prayer is not without its significance.

The meek and humble veil their faces and lie prostrate; the Greek, who stood erect with up lifted countenance offering soul and body to Apollo, the god of health and beauty, furnish us not only a most perfect type of physical strength and beauty but his intellectual power has been the admiration of the world.

Physical and mental life, in the race, in the individual, come into being; pass through simple to complex stages by a slow process of development; reach their zenith of power and return, making the cycle complete. But a slight disturbance in either body or mind, a disease, a passion has a tendency to undo shortly what has been a long and difficult process of growth.

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